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FORM OF SEEDS AS A FACTOR IN NATURAL SELECTION IN PLANTS.

BY ROBERT E. C. STEARNS.

THE present aspect of the fields in the immediate neighborhood of the south grounds of the University of California, at Berkeley, when compared with their general appearance five years ago, when the flora of the locality was first noticed by me, exhibits a marked contrast; and though during this time the varying character of the vegetation from year to year attracted my attention, the altered physiognomy of the fields particularly impressed me this past season, and curiosity has led me to seek for the causes which have produced what may be regarded as a most striking change.

The complexity of questions of this kind is increased, not only through the simpler factors involved, some of which are given below, but by the sequence of relationship of such factors to each other, which it is difficult to detect.

The climatology of the seasons during which such changes have been progressing;—the tillage of proximate lands, and the introduction of new plants, or of plants new to a locality, through this agency or by other artificial means more or less direct, which follow the settlement of a region;—other changes which follow through neglect of tillage, as where the cultivation of farming lands is abandoned, as is generally the case where such lands are divided and cut into small parcels for village or town plats or lots;—these are a few of the more conspicuous agencies which produce changes of the kind mentioned herein, in the local flora of such neighborhoods. Again, the time required for the growth

of a plant, from the sprouting of the seed to maturity, differs greatly in different plants, and the seeds of some plants germinate in much less time than the seeds of others. From this cause the aspect of the fields changes during the same season; those plants whose seeds start quickly and attain maturity in the shortest time, dominate for awhile and give one aspect to the fields in the first part of the season, and those plants whose seeds sprout slowly only reach maturity after the earlier have passed their prime or died, then dominate[1] and later in the season give to the fields a a different complexion or appearance.

The occurrence of these changes and the domination of this or that plant inside of or within the number of plants which form the flora of a certain region, may be conspicuously modified, in one year or season as compared with another, by the character of the season as previously referred to. As some plants thrive best with only a moderate supply of moisture, and are dwarfed, decreased in number of individuals or suppressed by the "drowning" of the seeds as the farmers call it, through excess of "wet" —so the latter might be highly favorable to the germination of the seeds and earlier development of the plants of some other species, which in normal or ordinary seasons would appear much later.[2]

The effect of only one such season might extend through several seasons, and materially modify the landscape features in its annual plants for a period of many years.

Without further enlarging in this direction on certain points which have been referred to, as they cannot properly be passed unnoticed, attention is called to another class of factors, not generally recognized, but of sufficient importance not to admit of exclusion, wherein natural selection is illustrated as performing its part in a different way.

The domination of "the fittest," the character of a season con-

[1] Thus *Madia sativa*, popularly or unpopularly known as "tar-weed," and obnoxious to pedestrians on account of its gummy exudation which injures clothing, though inconspicuous in early summer, later in the season becomes a prominent plant.

[2] In considering this point the frequently recurring discussion of what may be entitled "Cheat *vs.* Wheat," is brought to mind; some farmers contending that in seasons of unusual "wet" the wheat turns to cheat; others that the cheat, which in ordinary seasons is kept back, suppressed by the wheat (which makes the earliest start and quickest after growth, therefore maturing first), in unusually wet seasons gets the start of the wheat and dominates the field for that season. (Cheat is the local or vulgar name for *Lolium temulentum*.)

sidered, has been inferentially if not directly shown, where the effect of an unusually wet season is referred to; so certain plants which now dominate in my immediate neighborhood illustrate how natural selection has assisted, to say the least, in producing the change in the open fields near my residence in Berkeley, through the advantage which one form of seed has over seeds of a different form. And this aside from its interest to the scientific observer, is of special interest to the farmer, for it enters into the economics of his business, as may be seen further on.

Only a few years ago the entire region hereabout, from the hills to the shore of the bay, was either farmed or used for pasturage. Where not tilled, over large portions of this area, the wild mustard (*Brassica nigra*) abounded, and was regarded by the farmers as a pest; it grew and thrived nearly everywhere, and often attained a height sufficient "to hide all of a standing horse but his head." During later years the mustard has surrendered a part of the field to an (introduced?) turnip and radish, plants of the same order, with smooth seeds, and all three of these have been giving way, gradually yielding to other plants, native and introduced.

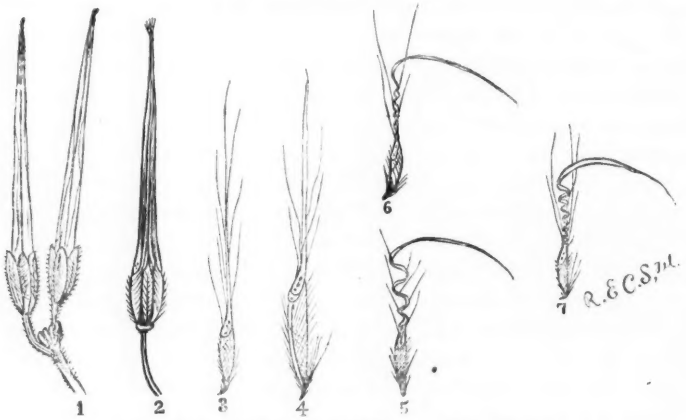
The mustard may, in some localities, regain in part its lost supremacy, through the assistance of man, as the seed within a few years has become of economic importance, and is now prepared for culinary purposes, and is also on the list of products in the export trade of the State.[1]

The principal plants within the more limited area first mentioned in this paper, to which these smooth-seeded *Cruciferæ* have been gradually yielding, have seeds of a different form. One of these is the *Alfillarilla*, or "filaree," by which name it is more generally known, a plant which is closely related to the geraniums, if we may judge from analogies of form in leaf and flower, structure of seed receptacle and shape of seeds. This alfillarilla, as it is called by the Spanish Californians, is an *Erodium*, and two species grow here, namely, *E. cicutarium* and *E. moschatum*.[2]

[1] In 1875, 1013 centals, valued at $4849; 1876, 5458 centals, valued at $18,314; 1877, 5065 centals, valued at $15,412, and in 1878, 7552 centals, valued at $21,689, were exported to foreign countries, making a total for the four years of 19,088 centals of the value of $60,264.

[2] Cattle eat these readily and appear to be fond of them, but the latter species especially is not a desirable plant for milch cows, as it gives a disagreeable odor and taste to the milk.

This genus is a form of "cranesbill," and as will be seen by Fig. 1, and its gynæcium, Fig. 2, is somewhat like that of *Geranium maculatum*, as figured in Gray.



Crane's bill (Erodium) or Alfillarilla. From nature.

The latter figure, with the sepals removed, shows the ovaries with their slender bearded[1] styles or awns (Figs. 3 and 4 enlarged) *in situ*, cohering to the elongated axis of the receptacle.

It will be observed upon examination that the ovaries are in fact a barb-shaped sheath enclosing the seed, the surface of which is covered with short stiff hairs or small bristle-like spines visible to the unaided eye, but of course more conspicuous through a common lens. The tip of the barb is also peculiarly pointed and curved; produced from the upper end of the ovary (that opposite to the tip) is a thread-like process or style an inch or more in length, varying in different specimens, so that the ovary as a whole may be compared to a tiny arrow, which it much resembles.

Now if we examine an unripe specimen before the sepals have separated from it (Fig. 1), we shall find four to five of these miniature arrows (carpels) side by side, closely fitting together, being snugly packed around the prolonged central axis of the gynæcium, the base of which is sufficiently expanded or swollen to receive the tips.

After the blossom has withered and the ripening process

[1] It is presumable that the Spanish name *Alfillarilla* was suggested by these delicate filaments.

advances, it will be found that the arrows (ovaries) in these little bundles, or quivers, if it be allowable to so name them, exhibit a tendency to separate from the central stalk or axis of the receptacle, first curling upwards and finally falling off, or are blown out and distributed by the wind.

As soon as the ovaries are detached as above, their styles commence twisting (see Figs. 5, 6 and 7), and the delicate threads, as seen upon and along the slender shaft or style, are consequently thrown out at increased angle (sometimes at a nearly right angle), so that the entire ovary now presents somewhat the appearance of the skeleton or frame, as it were, of a parachute, which after a breeze has passed and the air is calm, causes it to descend vertically, barb downward, so that the tip first touches the ground; the end of the tip is also barbed, so that if the soil at the spot where it alights is at all loose, it holds on. If the weather is dry the style or awn becomes still dryer, which causes it to twist still more, and the torsion caused by increased desiccation, turns it deeper and deeper; while if the atmosphere becomes damp or a rain occurs sufficient to moisten the slender style, though but little moisture is required to relax the torsion, the bite or grip previously made is not lost, because with the softening of the style the barb or ovary is not twisted out; whatever hold has been gained is retained, and the torsion renewed with recurring desiccation, and so the process of planting goes on.

The small bristles on the surface of the ovary or sheath are set obliquely upwards to the axial length and assist in the process of planting. It will be seen that every alternation of atmospheric conditions, characterized by positive moisture or dryness, assists in the operation.[1]

The luxuriant growth of the cultivated geraniums in California is well known. In and around Berkeley nearly every yard has many plants of one or more varieties. On my premises are numerous vigorous plants of large size and of many varieties, including Pelargoniums.

[1] This is easily illustrated by the following simple experiment: Take a tumbler and fill it with sand; select specimens of the gynæcia or receptacles which are beginning to turn brown or approaching ripeness, that is while the seeds complete with barb and shaft are straight; place the barb sufficiently deep into the sand so that its tip is fairly set; it will soon be noticed as the ripening progresses, or as the awn or shaft begins to dry that it also begins to curl or twist, and that in curling it buries the barbed ovary deeper and deeper, as turning a corkscrew carries the same deeper and deeper into a cork.

The question naturally occurred, why have not these ornamental forms which have the great advantage over their wild relatives of the protection and fostering care of man, spread like the unprotected *Erodium* and divided the field with it or driven it out? The seeds are not infertile, for under the shade of the sturdy plants which produce them, protected during the hot dry summers by the leaves which fall from the parent plant and make the thin mulch which covers them, with infrequent and slight sprinkling during the long rainless season, hundreds of young plants may be seen in the fall which have sprung from the loose and slightly moistened soil and acquired their second pair of leaves. The carpels are of the same form as those in *Erodium;* few persons could detect any difference, and the awn or style twist in the same way. Upon critical examination, however, it was found that the tip (insertion point) of the carpel was covered with *soft silken hairs instead of rigid bristles*, too soft to act as barbs, and the insertion point is neither as sharp or stiff nor curved the same as in Erodium.

The seeds of all of these foreign forms which have been examined by me in this connection, are apparently dependent for distribution chiefly on the winds, for the delicate filaments along the style if not longer are more numerous than in Erodium, so that when the twist or torsion has occurred, they present a form well adapted for distribution by flight.

Darwin has noticed the advantage which winged seeds have in this respect, as well as those plants whose seed cups or receptacles have a rough exterior, which get caught in the hair or fleece of animals and are thereby transported from place to place. In this way also the seeds of the geraniums have some advantage, but as compared with those of Erodium, so far as planting by natural methods is considered, the advantage is conspicuously in favor of the latter.

I do not know how it is with the cultivated varieties referred to in their native country, neither can I assert how it might be with our Erodium forms if transplanted to another region; a different environment might induce a gradual modification in those peculiarities which in the environment of Berkeley are important factors in their propagation and the extension of their geographical domain. It is not difficult for a person who is familiar with the cultivation of plants, and who has had an experience covering

widely separated regions with different soils and climates to conceive of conditions which might give to Erodium a rank succulent and tender growth, which, continued for a few years might differentiate the rigid bristles and barb of its ovaries in the direction of greater flexibility; or on the other hand to modify the soft nap or pile on the surface of the ovaries as well as the flexible tip of the foreign geraniums in the direction of rigidity or spine-like stiffness. Those influences which induce succulent or ligneous tendencies in plants are to a great extent the factors in such variation.

The seeds of geraniums found in the highlands of Uruguay, as well as the seeds of certain other plants, exhibit the same interesting peculiarities.[1]

Notwithstanding the browsing of cattle the Erodium gained upon the previously conspicuous forms. Within the past two years, however, it has been losing ground, in some places more

[1] An exceedingly brief outline of this paper was read by me before the California Academy of Sciences, June 17th, 1878; subsequently my friend, Mr. X. Y. Clark, sent me the following clipping from *Nature* of March 1, 1877, which I had not previously seen:

"*Hygroscopic Seeds.*—I have lately received an interesting letter from Fritz Müller, in St. Caterina, Brazil, on the subject of hygroscopic seeds. He tells me that in the highlands of the Uruguay he has succeeded in discovering more than a dozen grasses, as well as a species of geranium, whose awns are capable of hygroscopic torsion. He has been so kind as to send me specimens of the grass-seeds, and many of them appear to be as beautifully adapted as those of Stipa, Avena, &c., for penetrating the ground in the manner which I have elsewhere described (Trans. Linn. Soc., vol. 1, part 3, p. 149, 1876). The most curious among the specimens received are the seeds belonging to the genus Aristida. In one of these the awn is longitudinally divided into three fine tails, six or eight inches in length, each of which twists on its own axis when the seed is dried. These tails project in three directions and more or less at right angles to the axis of the seed, and Fritz Müller states that they serve to hold it in an upright position with its lower end resting on the ground. The seed is pointed and barbed in the usual manner, and when it is made to rotate by the twisting of the awns, it evidently forms a most effectual boring-instrument, for Fritz Müller found many seeds which had penetrated the hard soil in which the parent plant was growing. Another species of Aristida is interesting to me, because it illustrates the explanation which I gave of the torsion of the awn of Stipa, namely, that each individual cell of which the awn is composed is capable of torsion, and their combined action results in the twisting of the whole awn. Now in this species of Aristida each of the three tails into which the awn is divided is capable of torsion on its own axis, and as the seed dries they twist up into a perfect three-stranded rope, just as the component cells combine to produce the rope-like twist of the Stipa awn. And as the tails wind together and form the strands, the seed is made to rotate and thus bury itself in the ground.

"Down, Beckenham, February 19. FRANCIS DARWIN."

The Transactions referred to in Mr. Darwin's foot-note are not within my reach, and the article referred to by him, is unknown to me. I am curious to learn how far my observations and comments, made quite independently and without knowledge of anything elsewhere written, may agree with or sustain previous writers, or be corroborated and sustained by their observations.

rapidly than in others, through the conquering advance of another plant, a form which, being not only worthless as food but repugnant to cattle, is not molested by them in its onward march for supremacy, which over large areas it has already achieved, to the nearly total exclusion of Erodium.

This latter is what is known as barley-grass, or false barley, *Hordeum maritimum*, of which a spikelet is shown in the following figure (8).

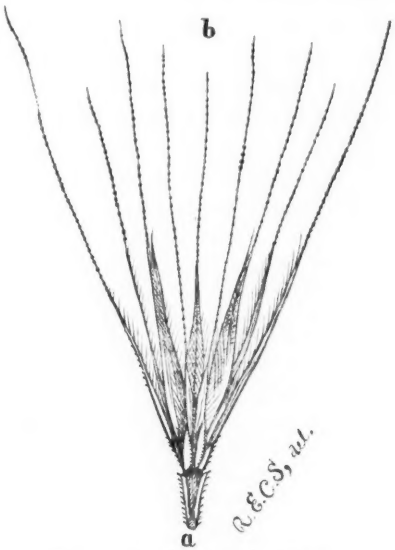


FIG. 8. Spikelet of Darley Grass.

Upon a careful examination it will be seen that the entire spikelet throughout is closely set either with short rigid bristles (as on the glumes and palea) or with minute sharply-pointed barbs as exhibited in the awns throughout their entire length, and on the edges of the arrow-shaped base or stem (insertion point) of the spikelet. Upon the long bristle-like awns these barbs are closely set, but are so very small as not to be at first detected; on pulling one of them through the fingers in a direction from the tip *a* towards the extremity of the awn *b*, no difficulty is encountered, it may be done with ease; but on pulling it in the opposite direction, namely, from *b* towards *a*, resistance ensues from the multitude of minute barbs, and the effort, if persisted in, results in the breaking of the awn.

The spikelet as a whole may be regarded as a wonderfully ingenious, compound and effective barb, having through the angle of its various parts and the length of the awns, all of the advantages of the parachute form which Erodium and the cultivated geraniums referred to derive from their twisted styles with fine lateral hairs, for floating in the air *and for poise in ultimate descent.*

The principal advantage which Erodium has over this Hordeum is in the hygroscopic torsion of the styles[1] or awns; this is more than balanced by the preponderance of barbs and bristles in Hordeum, all of which are set at some angle outward and upward, while the spoon-shaped basal nib, arrow-head or insertion point, whichever it may be termed, is perhaps equally well adapted as the same part in the carpels of Erodium, for biting and holding on; once inserted, every motion it receives, whether from the wind or other source only inserts it deeper and deeper, and in this the nib or insertion point is assisted by the other parts of the spikelet. Another and probably the chief advantage which the barley-grass has over Erodium is in the greater number of seeds (three in a spikelet) in a single plant; recurring again to the fact that cattle dislike it on account of its wiry, prickly character, which gives it almost perfect immunity or protection from their browsing, it is easy to perceive why it has become nearly if not quite "master of the situation."

To the farmer it is a pest and to the pedestrian a nuisance, as the spikelets stick into the trowsers around the foot, working in deeper and deeper with every motion, often crawling upwards as far as the top of the boot-leg, where if the stocking is long and extends above, it catches and follows down into the foot, irritating the flesh and compelling a halt in order to remove the annoyance.

Under a microscope lens the main barb (insertion point or nib) is an interesting and curious object; the unshaded edges (see figure) and the tiny barbs upon the same are translucent, being

[1] "A wild oat * * * * * the *A. sterilis* of botanists, is remarkable for the hygrometric properties of the seed. Two grains usually grow together, and they have a stout, bent and twisted awn. When the oat is ripe it falls out of its glume, and in warm dry weather may be seen rolling and turning about on its long ungainly legs as they twist up in consequence of their hygrometric quality. They turn and tumble about till their awns are so twisted that they can twist no further. They then remain quiet till the dew falls, or they are moistened by a shower, when they rapidly untwist and run about as if anxious to escape from the wet."—*Baird's Dict. Nat. Hist. p.* 27.

nearly pure silica; so also are the minute barbs upon the awns; and the short bristles on the surface of the ovaries in Erodium resemble, in miniature, the spiny bones in the dorsal fin of a perch.

Other bearded or barbed-seeded or rough-burred plants have increased in several places within the region referred to in this paper, among these are the burr-clover (*Medicago denticulata*) and the thistles (*Centaurea melitensis* L., and *C. solstialis* L.), both introduced species; the barley-grass, however, has the advantage over all others and is likely to maintain it.

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A SPECULATION ON PROTOPLASM.

BY PERSIFOR FRAZER, JR.

THE researches of comparative anatomists in late years have thrown much light upon the mode of development of the germ or embryo to the adult form of the species from which it is derived, and by the labors of Haeckel, Huxley, Cope, and others, much encouragement has been offered to the hope that man will yet push his knowledge of the processes of the development of life at least so far into their infinitesimal beginnings that the highest powers of the microscope and the most delicate appliances of physical science can no longer aid him. In this gradual triumph over what at first seemed insurmountable difficulties, many lines of interesting speculation are opened up, which, though lacking the permanent value of demonstration, are not without a certain use.

One of these is connected with the material out of which these wonderful structures are built; a material seeming to form the common point of intersection of all lines of organisms. For the latter, though widely separated in their several states of perfect development, when traced towards their origin, exhibit more and more striking resemblances and analogies; and they consist of a common substance, namely, the ultimately structureless (or amorphous as it is sometimes perhaps too hastily called) protoplasm or sarcode.

This wonderful substance which composes the simple cell of plant and animal, is capable of a distinct and individual life, and its methods of growth and multiplication (or rather division) have been beautifully demonstrated by many eminent naturalists. And wherever the phases of this chameleon may be observed, each is the easily recognizable child of all it has passed, and the common parent of all beyond and above it, howsoever divergent may be the path. But it is the vulgar error to misunderstand this analogy (as in the relations of man and monkey, etc.) when criticizing the doctrine of evolution. For only on the trunk do all divergent forms unite. No *bough* is parent to another, but they are brothers of the same parent stem.

This ultimate organic matter, or common building material, if not identical in chemical composition, is at least always composed in the main of the same few elements.

Robin's composition of the amniotic fluid of a fecundated ovum[1] contains:

	Per thousand.
1. Water	991.00 to 975.00
2. Albumen and mucosine	0.82 to 10.77
3. Urea	2.00 to 3.50
4. Creatine and creatinine	not estimated.
5. Sodium lactate	trace.
6. Fatty matters	0.13 to 1.25
7. Glucose	not estimated.
8. Potassium and sodium chlorides	2.40 to 5.95
9. Calcium chloride	trace.
10. Sodium carbonate	trace.
11. Sodium sulphate	trace.
12. Potassium sulphate	trace.
13. Calcium and magnesium	trace.
14. Phosphates and sulphates	1.14 to 1.72
Sum	997.49 to 998.18
Leaving undetermined, and to be divided between creatine, creatinine, sodium lactate, glucose, chlorides, sulphates, etc., and loss	2.51 to 1.81

This analysis does not, it is true, represent protoplasm from the simplest structures, but that which is used in organic edifices of a relatively high state of complexity; nevertheless the table is valuable as showing that despite the very heterogeneous nature

[1] See Flint's Text-book of Physiology, p. 903.

of this fluid, the number of elements which essentially compose it is few, thus:

Water	H_2O	
Albumen	C, H, N, O, S, slight variations in composition.	Molecule
Mucin	$C_a H_b N_c O_d$ variable.	[not known.
Urea	$N H_4 (C N)$	
Creatine	$C_4 H_9 N_3 O_2$	
Creatinine	$C_4 H_7 N_3 O_2$	
Sodium lactate	$Na_2 (C_3 H_4 O_3)$	
Fatty matters	$C_a H_b O_c$	0.013 to 0.12 p. c. per thousand.
Glucose	$C_6 H_{12} O_6$	
Mineral salts	KCl NaCl $CaCl_2$ $Na_2 CO_3$ Na_2SO_4 $K_2 SO_4$	traces.
Magnesian and calcareous phosphates & sulphates	$Mg_3 (PO_4)_2$ $Ca_3 (PO_4)_2$ $Mg SO_4$, $Ca SO_4$	0.11 to 0.17 p. c.

By glancing at the above tables it will be seen that the bulk of this fluid is made up of the type elements H^{I} O^{II} N^{III} C^{IV}, and these are *essential*, while sulphur, sodium, potassium, chlorine, magnesium, calcium and phosphorus are more or less accidental, or at least make up but a small part of its substance (*i. e.*, 0.4 to 1 p. c. at the highest estimate).

Even here, then, in a highly complex animal fluid, one about to commence the architecture of the various parts of one of the most complex animals in nature—man; the bricks, though most diverse in form, color and durability, are almost altogether composed of the same four simple substances which make the waters, the atmosphere and the plants, viz: C N O H.

But this conformity to rule, which would make these elements the only four necessary constituents of organisms, though close, is not exact. Sulphur always occurs, though in small and varying quantity. Phosphorus is generally present as an inorganic compound.

Nor is it known, (1) how greatly this material may vary in constitution and still subserve the needs of the growing thing which assimilates it; (2) how greatly the needs themselves of a race of growing things may alter with gradually changing circumstances. Has it always been necessary to build living things out of three combustibles and a diluent? When one attempts to speculate upon the *possible* answers to these now unanswerable questions, the difficulties crowd thick upon him. In the early history of the universe (or better, of our own planetary family) was it possible for living beings to exist? What constitutes a living being? Some physiologists hold nutrition and reproduc-

tion to be the necessary concomitants of life. Others reject the latter on the ground that animals, like the working bees and the sterile ants, not to speak of the hybrids, do not fulfill it.

All seem to agree that life is a manifestation of force, but so is crystallization. Crystallization, or inorganic life, however, seems to differ from organic life in this, that the ultimate components of the structure due to the latter are cells or irregularly-shaped sacs with or without skin, nucleus and nucleolus, and if this cell is broken up into parts it does not simply become two smaller but similar bodies, but either commences to disintegrate and fall to pieces or remains a broken and *dead* cell. In the former case the smallest constituent part yet reached is similar to, or at least connected by, rigid geometrical laws with the largest form in which it manifests itself.

By inductions based by mineralogical microscopists on the analogies in the behavior of matter in the magnetic field and in polarized light, it is rendered probable that each of the constituent molecules of a crystal is allied to the crystal itself in its form, and that both forms are due to what might be called stereopolarity, or the interplay of several (*i. e.*, more than two) polar forces acting along different axes, which holds the molecules of solids together, and gives the latter their characteristic forms. The results would necessarily be the repetitions of the same form or of the crystallographic analogues of that form (*i. e.*, different derivations in the same crystal system) and the growth of monsters which are so often met with.

Supposing this definition then to stand, the difference between organic growth and crystal growth would be that in the one case the product is dissimilar, in the other similar to the component parts.[1]

But is a fundamental distinction reached here?

Is it possible that beyond the range of the microscope there are minute forms composing these cells which are each in itself geometrically regular, yet constituting in the aggregate an ungeometrical body as the starting point for life-building?

Considering molecules of matter as inert and acted upon simul-

[1] The curious effects produced by the twin structure of crystals, as for example the production of an apparently hexagonal crystal by the union of several which are rhombic (chrysoberyl, etc.), offers no exception to the rule since the analogy spoken of still exists between the rhombic (?) molecule and each twin.

taneously, but with different degrees of force in different directions, then if those similar molecules were distributed evenly in any menstruum, there would necessarily result such a grouping of them as to form definite geometrical figures, whether these forces were those of attraction or repulsion or both together. It is possible, but not proven, that the different atomicities or atom-saturating powers of different elements may be due to different numbers and positions of these magneto-polar axes. From the grossest to the smallest manifestation of growth force; from the long neck of the giraffe to the segmentation of the ovum, there is observable but the interaction of polar forces, producing results, however, which are most dissimilar. In such large masses as we can see, these are modified by each other, in great measure, so as to produce curves instead of straight lines, as the pendulum does when struck sideways during its plane oscillation; but a multiplicity of polar forces thus interacting will account for all the phenomena.

There is no ground for supposing that these forces so patent in masses large enough for us to observe, cease to act upon matter even when in the state of finest comminution. And if they do, the result of a concourse of molecules, whether of organic or of inorganic origin, under the direction of polar forces must produce geometrical form.

The only means of testing whether this is the case in these organic cells (since the bodies, if they do exist, must be too small to be capable of being seen under the most powerful microscope) is by the employment of a more delicate test than the recognition of form, and such a test is the modification of color by transmission through thin films of them. The waves of light in passing between the constituent atoms of a body, experience a retardation proportionate to the density of the medium; which is only saying proportionate to the mean distance of the atoms apart, which again is governed by the amount of the attractive force exerted in a given direction. Bodies in which the density is equal in all directions retard the passage of light equally in all directions, whereas if the density be different in different directions the retardation will be different also and a new phenomenon will result.

It is known that nearly all organic structures have the property of polarizing light, and hence are built up by the interaction of polar forces of different intensity, and if the first proposition

be correct, the establishment thus of the existence of several different independent lines of force renders the existence of a geometrically constructed organic unit at least probable.

Why these smallest organic molecules do not construct the perfected product on their own model, while the analogous crystalline molecules do, is a problem for future solution.

If the sarcode or protoplasm be susceptible of slight chemical changes, and in fact suffers such changes without losing the power to fulfill its function of repairing waste tissue, then in the progress of the decay of worlds, and the changes of external conditions consequent upon it, Darwin's law of survival must inevitably be felt where an accidental alteration of the substance of the sarcode and the resulting changes impressed upon the structure enabled one animal to live where others perished. The formation of more combustible compounds, and the increase of the capacity of alimentation, for instance, might balance the tendency of the atmosphere of a cooling earth to depress the temperature of the blood below the living point. But why should it only exert its recuperative energy in the direction of maintaining the present condition of things? An amount of plasticity equal to this need is quite capable of changing the conditions of life themselves, and instead of rendering it possible for *man* to exist with blood at 99° Fahr., in an arctic world; to manufacture of man and his terrestrial companions, beings to whom that temperature would be normal and salutary.

To a limited extent it seems as though we were justified in accepting a difference of this kind in our present organic nature. How else than by a sarcode of different chemical constitution are the physical differences of race to be accounted for? How, indeed, is evolution to be accounted for according to the Darwinian explanation?

And if the change to varieties is thus produced, why not to species, genera, families, groups, orders, classes, sub-kingdoms;—why is it not possible that the very kingdoms of life and the forms peculiar to them may be altered in this way to suit the gradually changing external conditions of nature? The prejudice in our minds against the possibility of any living thing existing on the surface of the sun is based upon various conditions there, which in our experience are inconsistent with life. Amongst others may be mentioned, that to the best of our knowledge, 1st,

the temperature is above the fusing point of platinum; there is no solid land that we know on which objects could stand, and if there were the weights of the bodies that we know would be so great at the surface of the sun that they would be crushed. That our feet would find no resting place, or if they did, our strength would be insufficient to bear up the tons which our bodies would then weigh, and even if this were not so, our C N O H bodies would be dissipated as gases. The reverse is the case in the cold cinders called asteroids. There the cold would instantly kill any living thing that we know.

But what is there to preclude the possibility of living things colder than frozen mercury, or hotter than molten platinum. In fact since the only manifestation of vitality we can know is the action of force upon matter, until these two components are obliterated, how can one predict the extinction of life?

This has some bearing on the ever recurring questions of immortality or existence after visible disintegration. But up to this point it has been assumed that the external conditions were being changed with extreme slowness. If only this obtained, there would seem to be no positive improbability of life in beings composed wholly of liquids or gases.

Of course it is to ridicule the subject to conceive a being whose epidermis of platinum resisted successfully the waste of oxidation even at the prevailing red heat, and whose stomach of porcelain would melt up the metallic silicates and send them coursing through wrought iron arteries to be assimilated into metallic or ceramic organs, and to pass through the usual stages of activity, decay, and re-utilization; while the siliceous brain and the asbestos nerves quivered with sensations of pleasure forever denied to us combustibles. Yet it is not too much to claim that no sufficient reason can be given for confining the material out of which sentient beings can be constructed to the four type elements above referred to; nor is there any reason apparent why a gradual change in the organs of assimilation as well as in the material assimilated should not accompany and compensate all gradual changes in the outside world, thus rendering the thread of life continuous through beings more diverse than any that we yet know.

ON THE FERTILIZATION OF SEVERAL SPECIES OF LOBELIA.[1]

BY WILLIAM TRELEASE.

AMONG our wild flowers few are more conspicuous than the cardinal flower (*Lobelia cardinalis*), which, by its racemes of large, velvety red flowers, attracts many a wanderer into otherwise very unattractive marshes. The large blue lobelia (*L. syphilitica*) forms also a very conspicuous feature of such places in late summer and early autumn, while the Indian tobacco of the herb doctors (*L. inflata*) is known to everybody. In addition to these, some twenty other species grow wild in North America, and lovers of flowers know well the cultivated creeping lobelia (*L. erinus*), with its pretty blue and white flowers. To any observer not a botanist these are easily known as lobelias by their two-lipped flowers with the tube of the corolla split nearly or quite to its base on the upper side, while from the cleft thus formed the stamens project, their anthers being united to form a tube which is frequently bent downward at its extremity, while the style passes through its center.

To one interested in the devices by which nature causes cross-fertilization to be effected, a closer examination will reveal some additional facts. Nectar is so abundantly secreted, in sunshine, within the base of the filaments—which are there split to give access to it—that the basal part of the flower is often quite filled with it. The structure and development of the stamens and pistil are essentially as Prof. Todd has described them in the January number of the NATURALIST, but in addition to the shaking of the anthers he mentions, I think that there is sometimes another reason for the discharge of pollen on the back of an insect entering the flower. The style is in contact with the stamens only by its ring of collecting hairs, and a slight upward pressure on the tip of the anther tube would move the anthers backward without moving the style, and would thus imitate the action of a pump

[1] In the Ann. and Mag. of Nat. Hist., 1868, Vol. II, p. 260, is a very good description of the mode of fertilization of the "common blue" Lobelia. Hildebrand and H. Müller, in Germany, and Delpino, in Italy, have also described the fertilization of species of this genus; but as their writings are inaccessible to many American readers, it is thought that the following observations, made in the summer of 1878, at the Botanical Laboratory of Cornell University, may be of some interest. The insects were kindly named for me by Dr. Packard and Mr. Cresson.

in which the piston remains stationary while the barrel moves—pollen would be pumped out of the moving anther-tube by the stationary style with its ring of hairs. Moreover, when the staminate stage of the flower (lasting about three days in *L. erinus*) is ended, and the style protrudes from the orifice of the anthers, the hairs on the style become reflexed, thus apparently serving to prevent such pollen as is not infrequently left in the anther tube from falling out upon the papillose stigma when this is unfolded.

In *L. erinus*, and twelve out of fourteen other species, indigenous and foreign, which I examined, I found essentially the relations of corolla and stamens described by Prof. Todd; and in all cases, the lower lip of the corolla is provided at its base with two longitudinal ridges, including between them a guiding groove which leads into the tube of the corolla directly beneath the tip of the anthers (Fig. 1), thus forcing a bee to enter every flower in the same way. In the thirteen cases mentioned the two lobes of the upper lip of the corolla are nearly erect, as if to prevent an insect from creeping back on the tube of the corolla and obtaining nectar surreptitiously through the cleft on its upper side. The corolla-tube is also comparatively broad, and an open passage is left between its lower border and the filaments (Fig. 3), thus giving access to such insects as small bees, which creep bodily into the corolla in order to reach the nectar within its base.

In *L. cardinalis* (Fig. 4) and the Hawaiian *L. macrostachya* the lower lip of the corolla is pendant, and there is but a narrow passage between the corolla-tube and the stamens, which in these species are greatly elongated, with the tip of the anther-tube at a considerable distance from the corolla (Fig. 4). The two lobes of the upper lip of the latter are often horizontal or even deflexed, appearing to serve their purpose best when in these positions. The flowers go through the same dichogamy as the others, but they are adapted to profit by the visits of large Lepidoptera or even of humming birds, since a bee cannot enter the narrow and elongated tube of the corolla, while even if it could it would encounter the tip of the anthers or the protruded stigma only by the merest accident. On the other hand a hawk-moth or humming-bird could easily poise itself before the flower, and, while removing nectar by its long slender proboscis or bill, this would come in contact with the anthers or stigma, since the guiding-

groove of the corolla would force it to visit each flower in such a position as to secure this result.

I have repeatedly watched for hours plants of *L. erinus*, *L. inflata*, *L. kalmii* (Figs. 1 & 2) and *L. syphilitica*, growing in abundance near our laboratory; and on sunny days I have never failed to see them visited by many bees, though I have often watched isolated plants in vain. On *L. erinus* I have seen numerous individuals of *Augochlora pura* and several species of *Halictus*, and with the exception of one individual of the last-named species they always entered the corolla from the front, creeping in bodily if small enough, or forcing their heads in if they could not enter. I always found them well dusted with pollen. The exceptional individual of *Augochlora pura* was seen to visit eight or ten flow-

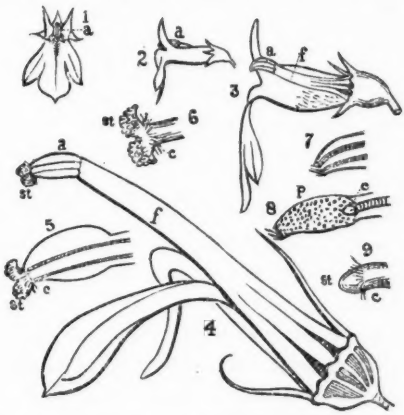

FIG. 1.—*Lobelia kalmii* from in front, slightly enlarged. FIG. 2.—The same from the side. FIG. 3.—Longitudinal section of the same, enlarged. FIG. 4.—Longitudinal section of *L. cardinalis* (X 2). FIG. 5.—Section of anther-tube of flower of *L. kalmii* in the second or pistillate stage, enlarged. FIG. 6.—Stigma of the same, enlarged. FIG. 7.—End of anther-tube of a flower in the first or staminate state, showing the hairs closing its mouth, enlarged. FIG. 8.—Section of the same, enlarged. FIG. 9.—Stigma of the same, enlarged. In all of the figures *a* indicates the anthers; *c*, collecting hairs; *f*, filaments; *p*, pollen; *st.*, stigma.

ers, and it always settled upon the tube of the corolla near its base, and inserted its proboscis through the cleft from which the stamens protrude, thus obtaining the nectar of the flowers without transferring their pollen. Other individuals of this species were seen to visit the flowers properly, and, although unable to creep well into the corolla, they forced their heads in far enough to

reach the nectar with their protruded tongues, and they always transferred pollen. On several occasions I saw small humble bees visit flowers of this species, attracted by their color from neighboring beds of verbenas which they often visited; and one of them when killed and examined under the microscope was found to have its proboscis dusted with oval pollen grains, not to be distinguished from those of this lobelia. For some reason I did not see a single hive-bee on these plants, although where they are abundant they are said to frequent these flowers in large numbers.[1] Twice I saw yellow butterflies (*Colias philodice*) visit these flowers, but though I carefully watched them as, poised on the corolla lip, they sipped the nectar, I could not see that they removed any pollen, their proboscides being slender enough to penetrate the tube without touching the anthers, still, pollen may be carried by them occasionally. On several occasions I saw specimens of a fly (*Calliphora vomitoria*) busily engaged at what appeared to be eating pollen, and their foreheads always came in contact with the anthers or stigma, from both of which, as well as the underlying surface of the corolla, they appeared to gather the pollen. Specimens of another fly (*Syritta pipiens*) were seen repeatedly on the lip of this flower, but I doubt if they were after pollen, and I never saw them come in contact with the anthers or stigma.[2]

On *L. inflata* I captured only *Augochlora pura* and a species of *Halictus*, but observed many individuals of these species, and believe that I saw at least two other species of quite similar size but very different appearance.

On *L. kalmii* specimens of *Augochlora pura* and two species of *Halictus* were taken.

Very many humble-bees of all sizes, and probably belonging to several species, were seen to visit flowers of *L. syphilitica*, behaving precisely as did the smaller bees on the species previously spoken of. Numerous small bees belonging to several species, chiefly of *Osmia* and *Ceratina*, were also seen to visit these flowers, but they were too small to brush the anthers. On one occasion I saw several individuals of *Ceratina dupla*, a small bee, enter the tube of the corolla, and afterwards retreat. Then,

[1] Darwin, Cross and Self Fertilization, American edition, p. 420.

[2] Hildebrand has described in the Botanische Zeitung, 1870, p. 638, cases in which the stigmas of this species could not escape from the anther-tube, and, expanding there, were self fertilized.

elevating themselves, they were able to reach the end of the anther-tube, and from this or the protruded stigma they collected small quantities of pollen.

On several occasions I watched a few plants of *L. cardinalis* till twilight with no success, but as this species is not very plentiful in the swamps about Ithaca this is not to be wondered at. Once, however, after watching for several hours, I saw a single ruby-throated humming-bird visit the racemes of six or seven plants that I had collected and placed together in a pool of water within a few feet of the place where I sat. When sipping the nectar the bird balanced itself before the flower, and I could see that its bill always touched the anthers. Being necessarily at too great a distance to see whether there was pollen on its beak, I was obliged to rely upon the examination of a few stigmas, which, in anticipation of this difficulty, I had previously examined and marked. On one of these I found quite a number of pollen grains where previously I had found none. On others, on which pollen had previously been seen, there was plainly more. These cases show that pollen is thus carried, though apparently in small quantities. Though I saw no Lepidoptera visit this species, I see no reason why they should not do so, especially the *Sesias*, and if such be the case they will probably transfer pollen from flower to flower. Where many plants grow together a few observations early in the morning and in the evening will probably prove this to be the case.

To prove the almost self-evident fact that extraneous aid is needed to insure fertilization with the Lobelias, I carefully covered (with gauze nets supported by light frames) two plants each of *L. inflata* and *L. syphilitica*, on each of which I had artificially fertilized the only flowers then in the pistillate state. These flowers set fruit well filled with seed. One of the nets collapsed so as to be in contact with the plant, and several of the flowers of this plant set fruit; but in the two other cases, one of each species, none of the flowers not artificially fertilized produced seed, though their ovaries became more or less swollen. The fourth plant was not observed after being covered. Plants growing uncovered beside these, and others artificially fertilized from time to time and covered by similar nets, were fully fertile, showing that situation or enclosure did not cause this failure to fruit.[1]

[1] Darwin also states, Cross and Self Fertilization, p. 364, that *L. ramosa* and *L. fulgens* are quite sterile without insect aid.

As a rule, especially in plants like *L. syphilitica*, which are of simple habit, the flowers are visited by bees from the lowest one of the raceme upward, as has been observed by others to be the case with so many other plants. The humming-bird that I saw visiting *L. cardinalis* also acted in precisely the same way. As the lowest flowers are the oldest, and consequently the only ones in the pistillate stage of development, it is evident that they will usually be fertilized by pollen from a distinct plant, and after they are all fertilized, pollen is taken from flowers situated higher on the raceme for the fertilization of the older flowers of the next raceme visited. With the creeping *L. crinus* I have noticed that bees visit the flowers indifferently, alighting on almost any flower which protrudes from the tangle. But after once alighting they generally adhere to the branch on which this flower is situated, working upward upon it; though this is not invariably the case.

In many species, perhaps all, the style elongates sufficiently to cause the mature stigma to stand at a considerable distance without the anther-tube, thus making it still more certain that it will be brushed by an insect visiting the flower than is the case with the tip of the anthers, for a superabundance of pollen admits of an occasional failure to remove it, but it is imperatively necessary that each stigma be fertilized.

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A CONTRIBUTION TO THE ZOÖLOGY OF MONTANA.

BY E. D. COPE.

THE Territory of Montana, taken as a whole, is probably the most valuable tract of land which has not yet been placed under control of a State government, within the limits of the United States. As is well known, the diminished elevation of the Rocky mountains and adjacent plains, as well as the northward bend of the isothermal lines, indicate for Montana a milder climate than that of the Territory of Wyoming on the south, and that of Dakota on the east. Its agricultural wealth is greater than that of either of those Territories, and it is superior to both in the yield of its mines. Timber abounds on its numerous mountain ranges, and it is, par excellence, the range of the large game of North America.

My acquaintance with this region was chiefly obtained through

an expedition which I undertook in the summer and autumn of the year 1876. I left Franklin, Utah, by the Helena stage, which carries its passengers through parts of Idaho and Montana, reaching Helena in four days from the time of starting. The route first traverses the rolling country of Bear river, and then enters the sandy lava desert of Eastern Idaho. Passing this inhospitable region, we cross the main range of the Rocky mountains and enter Montana by the Red Rock valley, which is watered by one of the creeks which form the heads of the Missouri. Here commence the beauties of Montana scenery. The numerous parallel ranges of low mountains are capped by masses of lava, the remnants of an ancient outflow that once covered the country. The faces of this rock are vertical, often approaching columnar, and generally possess a serrate crest. The slopes below them, and the lower valleys, are beautifully green. Before reaching Helena a portion of the granite region is passed over. Here the scenery is of a different character. The more yielding material of the rock has given the hills more rounded forms, and huge masses of weathered boulders, piled in the most grotesque manner, are often seen. The timber is more abundant, and the hills abound in game, especially grouse (*Tetrao obscurus*, etc.). On their sides several species of *Sciuridæ* are numerous.

Continuing beyond Helena to the north-east, the Palæozoic region is reached. The stage route for Fort Benton passes through the Prickly Pear canyon, a narrow pass of a thousand feet in depth, between great walls of carboniferous rocks. After issuing from it and crossing a high mountain, the stage descends to the plains. Previous to visiting this region, I had not realized the fact that the same plains with which I had become familiar in Kansas and Colorado, extended west and north of the Missouri river, with all their peculiar scenery and products; the buffalo grass, the prairie dog and antelope, the yelping coyote, the owls, the prairie rattlesnake and the herds of bison. At Fort Shaw the Rocky range towers grandly on the western horizon, and on the east the Belt mountains rise abruptly in magnificent proportions from the level plain.

The road thence to Fort Benton is varied by ponds and "slews" whose proportions depend on the quantity of the rains. These are the homes of numerous Siredons, Speas and toads.

From Fort Benton eastward the Missouri flows between high

and often precipitous banks, and the elevated plain on the north side gives uninterrupted views of great beauty. To the north-east the red granite masses of the Bear's Paw mountains obstruct the view, and to the south, mountains of various outlines form the horizon. These are the Belt, Judith and Snowy ranges, and they enclose, with the bend of the Missouri river, an extensive plain. From this plain rise several table-topped masses, evidently remnants of old strata protected by an outflow of lava.

At the mouth of the Judith river the special object of my exploration began to claim attention, viz: the investigation of the beds of the Judith River Lignite formation and the extraction of their fossils. The results of this work are given in the Bulletin of the U. S. Geological Survey of the Territories, F. V. Hayden in charge, Vol. III, No. 3, 1877. The exploration included the valleys of the Judith river, Dog creek and Two Calf creek, and the canyons of the south side of the Missouri as far east as Amell's creek, and the corresponding situations on the north side of the river on the return to Fort Benton. These streams carve deep canyons through the yielding lacustrine and marine strata which underlie the plains, which often present scenery of terrible desolation and grandeur. The bluffs of the Missouri reach the height of one thousand feet in many places, and in but few localities are passable by wagons. The labyrinths of their branch canyons are only passable by pack animals, and the high land can only be successfully reached by a most careful discrimination of the main "divides," or water-sheds, from the innumerable spurs which diverge from them.

The plains of this region are neutral ground between the Crow and Sioux Indians, who are ever at war; and they have not been regarded as a safe abode for white settlers. The only Americans in the region are the few wood-choppers on the Missouri bottoms, and the freight and other agents of the Missouri river steamers and shipping houses, who for a few months of every year are stationed at Cow island. The country is practically left to the game, which is here generally unmolested excepting by occasional hunting bands of Indians.

While geological and palæontological exploration was the primary object of the expedition, a few zoölogical notes were taken, which I here record.

Mammals.—One of the characteristic mammalia of Montana

is the *Haplocerus montanus*, or Rocky mountain goat-antelope. It is not rare, and is said to be easily domesticated. The most southern and eastern locality at which I heard of its occurrence is the Prickly Pear canyon.

The abundance of game on the plains south of the Missouri is well illustrated by the experience of a day on which I rode from my camp to some bad lands which lay at a distance of perhaps ten miles from it. In the course of the ride I passed at least a dozen antelopes at different points, and the usual population of prairie marmots and several coyotes. On reaching the summit of a hill I came suddenly on four fine buck *Cervus macrotis*, and soon after descried a few bison grazing at no great distance. Passing a stream I surprised three does of the *Cervus macrotis*, and afterwards came upon the rather fresh trail of elk. On my return from the bluffs in the afternoon I encountered four grizzly bears together. They displayed considerable curiosity, and for some time seemed undecided as to the proper course to pursue; they advanced towards me one step and retreated two, and so alternately moving forward and backward they reached the edge of the rising ground upon which they stood; they then quickly disappeared behind it, and when they next came into view, were in full retreat some distance away.

Reptiles and Batrachians. — There was nothing noteworthy observed respecting reptiles. Not a tortoise was seen, and the only abundant snake was the *Crotalus confluentus*. This rattlesnake grows to its largest size in the Upper Missouri region, and is abundant in localities of different characters. The next most common reptile is the *Phrynosoma douglassi*, and after it the *Heterodon simus*.

Much more of interest was observed in the department of *Batrachia*.

Rana pretiosa Bd. and Gird. I found this species quite common in the Prickly Pear canyon and valley, associated with perhaps another and smaller species, which I did not succeed in taking. This west coast form is apparently confined to the damper mountainous regions, as I never met with it in any other part of the Rocky mountains, and it disappeared as soon as we entered on the plains. I observed a *Eutænia* in the same localities, but no Phrynosomas. The *Rana pretiosa* has shorter legs than the *R. aurora*, which with some varieties, can only be regarded as a subspecies of *R. temporaria*, so far as I can see.

Rana halecina berlandieri.—This abundant species replaces the preceding on the plains, and is the characteristic, and indeed the only *Rana* of the limited batrachian fauna of that widely extended district. On leaving the mountains this species immediately appears, accompanied by *Phrynosoma douglassi*, *Crotalus confluentus*, *Heterodon simus*, etc. The form which inhabits the plains differs in color and superior size from that found in the tide-water swamps of the Atlantic coast, on which account I have retained for it the sub-specific name at the head of the paragraph.

Spea bombifrons Cope.—This species is characteristic of the northern parts of the Plains and Great Basin. It was especially common in the region north of the Missouri river and eastward of Fort Benton. Before my arrival there, rain had fallen, and the ruts of the wagon trails were filled with water. These ditches contained numerous examples of this species, together with *Chorophilus triseriatus*, *Bufo dipternus* and *Amblystoma mavortium*. Their metamorphosis was completed by that time (August 20th), although some of the specimens were small.

In Idaho, near latitude 43° 30′, is situated a body of water known as Market lake. Its extent is variable, for it is said to be dependent for its water supply on the overflows of the Snake river, which is a few miles distant to the eastward. An old channel leads from the river to the lake, giving probability to the statement. At the time of my passage through the region, the water was unusually high, for a portion of the stage road with parts of numerous telegraph poles, was submerged. The lake appeared to be about ten miles long by six in width. The country surrounding it is arid, and the sand which represents soil, rests on a basis of lava. The stage halted for a short time to enable me to examine the shore of the lake. I found it to be lined with a wind-row of grasshoppers (*Caloptenus spretus*) which had fallen into the water and been washed up, some living, others dead. Among them I found numerous large fat larvæ of *Spea bombifrons*, occupying small spaces which they had cleared, quite out of the reach of the water. Their limbs were nearly fully grown, while their tails had suffered no absorption, and their jaws were toothless and cartilaginous; some quite larval in form, others with wider gape. They were engaged in eating the grasshoppers, and I detected several specimens with the entire insects in their mouths. In some instances the grasshoppers' bodies were too

large and projected from their mouths. These precocious larvæ were evidently air-breathers, and hopped about, presenting a curious appearance as they dragged their large tails after them. I found some adult specimens of *Amblystoma mavortium* also, along the waters edge. These observations were made on the 11th of August, 1876.

Chorophilus triseriatus Wied.—This widely distributed species I obtained at Franklin, on the Utah-Idaho boundary, and subsequently found it very common in the ruts of the wagon trails on the plains east of Fort Benton. In the latter locality it was generally of a bright green color.

Bufo dipternus Cope, sp. nov.—This toad I found abundant on the plains north of the Missouri river east of Fort Benton, in the wagon ruts of rain-water, in company with *Spea bombifrons*, etc. It is of about the same size as the latter species, and resembles it in various ways; it doubtless has similar fossorial habits, as it is furnished with a tarsal shovel of the same proportions, and has in addition a second tarsal bone produced into a digging spur. The prefontal bones are thickened in the same way, although not to the same extent as in *Spea bombifrons*, a condition, no doubt, directly connected with the habit of pushing aside the earth while excavating burrows with the feet. It is easily distinguishable from the Spea, by the ordinary collector, by its large dorsal spots, which are much better defined than are the small ones of the *S. bombifrons*. I did not find the *Bufo dipternus* south of the Missouri river; there its place is occupied by a very distinct species.

This *Bufo* differs from the *B. lentiginosus* and all its sub-species in the presence of two well-developed fossorial tarsal spurs, and in the large size of the internal one. In this respect it need only be compared with the *B. compactilis* Wiegm., from South Texas and Mexico. It is distinctly related to the latter, but is separable from it as a distinct species on account of (1) its much smaller size, reaching only half the dimensions, (2) the smaller size and obscurity of the tympanic membrane, which is only one-third the diameter of the eye-slit, while in *B. compactilis* it is one-half the same diameter, and is well defined, (3) the larger and truncate external tarsal spur, and (4) the coloration, which is quite distinct. The head in the adult *B. compactilis* is also distinctly shorter.

There are two faint straight supraorbital ridges, and a postorbital but no supratympanic ridge. The supraorbitals are united

by the enlargement of the posterior part of the prefontal bones, which forms quite a tuberosity in adults. These bones slope steeply, truncating the muzzle obliquely in profile to the nares; the latter then descends vertically to the lip border. The sides of the muzzle are flat. The length of the head to the line of the postorbital ridges is just one-fourth of the length to the extremity of the coccygeal style; it enters the same axis of the *B. compactilis* five and one-half times. The parotoid glands are wide ovals and are in contact with the postorbital ridges as in *B. compactilis*. The choanæ are rather smaller than the nares. The skin is roughened with small tubercles above and below, those of the superior surfaces being larger and more spaced. When the hinder leg is extended forwards, the end of the astragalus reaches the tympanic membrane. The posterior digits are shortly webbed at the base. Their extremities, like the spurs, are capped with brown horn, but these sheaths are readily lost in spirits, and with them some of the characters of the species.

In life the color of this species is ashen, marked with three pairs of large brown spots on the back. A similar spot crosses each eyelid, and there is a pair on the end of the muzzle. There are two or three large longitudinal spots on the sides which may unite into two bands, one above the other. The spots have blackish edges and paler centers with yellow or red tips on the tubercles; the ground is brighter round the spots. The limbs have similar large spots on their superior surfaces, and the palms and soles are yellowish. There are two large spots below the eye, and smaller spots on the tips in front. Below immaculate.

Length of head and body, m. .040; do. of head, .010; width of head behind rictus ovis, .016; length of fore limb, .020; do. of hind limb from vent, .048; do. of hind foot, .022.

This species is one of the handsomest of the nearctic species of the genus.

Bufo ? sp.—I have already alluded to this toad as representing the *B. dipternus* on the south side of the Missouri river on the plains of Northern Montana. I saw numerous specimens on Dog creek, but was unfortunately unable to preserve them on account of the want of spirits. The species is small and resembles the *Spea bombifrons* in its color much more nearly than does the *B. dipternus*, since it exhibits numerous small spots without margins. But it does not have the developed tarsal spurs of the *B. dipternus*, and resembles much more nearly the *B. lentiginosus*. I am under the impression that it should be considered a subspecies of that widely distributed toad.

Amblystoma mavortium Baird.—I have already mentioned finding this species in rain pools north of the Missouri, and on the

shore of Market lake, Idaho. Twelve miles northward of the latter is a much smaller body of clear water which is more permanent in its character, since I was told when there that it had not been dry since 1871. On the shore I found several specimens of the *Amblystoma mavortium* in various stages of transition from the larval condition. They mostly presented stumps of the branchial processes, with a greater or less degree of atrophy of the fimbriæ. These animals occupied holes the size and shape of their bodies excavated vertically in the sand, from which their heads protruded. They were so situated as to be overflowed by every slight change of level of the water, which also kept their holes full. This situation is especially adapted to a state of transition from a branchial to a pulmonary respiration.

This is the only species of salamander I observed in Montana. Its abundance in the central district of the nearctic region is now well known, and a full account of its numerous transitional and color forms will be found in my monograph of the genus *Amblystoma*, published in 1867.[1]

Fishes.—The food fishes at Fort Benton are the *Lucioperca borea*, the *Scaphirhynchops platyrhynchus* (sturgeon) and the *Lota maculosa* (ling). Of these the *Lucioperca* is easily the superior, but the sturgeon is not a bad fish. The "chub" of the river at that point is the *Pogonichthys communis*, which sometimes grows to a foot in length, and is the usual bait for hooks. *Hyodon tergisus* is common there also. In the mountain streams at the heads of the Missouri and its tributaries the trout and white-fish (*Coregonus villiamsonii*), are the universally prized pan fishes. I heard that the grayling (*Thymallus montanus*) occurs occasionally with them, but did not see it myself. The following is a list of the species which I observed in the Missouri river and its tributaries. Of course it is a mere contribution to the subject, as I did not fish extensively at any point. The larger number of species were taken at the lower part of the course of Battle creek, which empties into the west side of the Missouri not far north of the mouth of the Moreau, Dakota. At the season of the year (October) when I visited it, the creek was reduced to a chain of pools, which occupied hollows in the clay shales of Cretaceous No. 4. The alkaline substances from these shales saturated the water, but this did not prove fatal to very numerous specimens of eight species of fishes.

[1] Proceedings Academy Natural Sciences, Philadelphia, p. 166.

Percomorphi.—Lucioperca borea Richdn.—Abundant all along the river. The specimens agree very nearly with the description of *L. canadensis*, given by Jordan,[1] but I find six long pyloric cœca, two a little shorter than the others. The second dorsal rays number nineteen in three specimens, the last one split. Girard gives the number as twenty.

Lota maculosa Leseur.—Common; Battle creek.

Nematognathi.—Ichthælurus punctatus Raf.—Pools left by the river near Battle creek.

Plectospondyli.—Semotilus corporalis Mitch.—Battle creek.

Pogonichthys communis Gird.—Fort Benton, Judith river.

Rhinichthys maxillosus Cope.—Battle creek.

Phoxinus milnerianus Cope, sp. nov.—Form elongate; chin slightly beyond upper lip. Pharyngeal teeth 2.5–4.2. Scales in fifteen longitudinal rows between the dorsal and ventral fins. Diameter of orbit equal to length of muzzle, and entering length of head three and a-half times. The latter enters the length to the origin of the caudal fin four times. The greatest depth enters the same five and a-half times. The dorsal fin originates above a point behind the entire base of the ventral. Radii D. I. 8, A. L. 8. The mouth is rather large, the extremity of the maxillary bone extending nearly to the line of the pupil of the eye. The head is rather flat above and wide, the parietal width being about one-third the length between the last dorsal ray and the base of the caudal. The distance to which the lateral line extends is unknown because the scales of the posterior part of the body are lost.

Color brownish-olive above; below silvery. A black band, not well defined on the borders, extends from the end of the muzzle to the base of the caudal fin, where it terminates in a black spot. A reddish spot at the base of the anterior dorsal rays, muzzle dark. Length, m. 0.065.

This species differs from the *P. neogæus* Cope, in its slender form and small number of rows of scales. It is dedicated to my friend Jas. W. Milner, of the U. S. Fish Commission.

Chrosomus sp.—Small individuals from Battle creek.

Hybognathus evansi Girard.—This fish was very abundant at Battle creek. It has the slender suborbital bones of the *argyritis* group, with the small eye of the *nuchalis* group, and is a well marked species.

Hyborhynchus nigellus Cope.—From Battle creek; originally described from Colorado in the Report of Lieut. G. M. Wheeler.

[1] First Annual Report of the Ohio State Fish Comm., 1877, pp. 69–87.

I may here mention that the *Hyborhynchus siderius* Cope, is a *Hybognathus;* its enumeration under the former head being the result of some one's inadvertence. The *Rhinichthys maxillosus* of that report I believe now to be distinct from the species I called by that name, and I propose that it be termed *R. transmontanus.* It differs from the more eastern species in having the dorsal fin equidistant between the base of the caudal and the end of the muzzle, and in having the longitudinal series of scales below the lateral line more numerous (12–13) and equal to the number of scales above it. In *R. maxillosus,* from Battle creek, they number $\frac{10\text{-}12}{7\text{-}9}$.

Isospondyli.—Hyodon tergisus Les.—Judith river and pools of the Missouri near Battle creek.

Coregonus villiamsonii Gird.—Heads of the tributaries of the Upper Missouri.

Ginglymodi.—Lepidosteus productus Cope,[1] and *L. otarius* Cope.—I found both these species in pools left by the Missouri river near to Battle creek, maintaining their characters exactly. They differ in both proportions and color. The *L. productus* is lead colored above and white below, the colors gradually commingling on the sides. There are no spots on the sides nor at the base of the tail, and there are three spots on the caudal fin. In *L. otarius* of the same small size, the darker lead color of the back is abruptly separated from the white of the belly by a row of dark spots, and there is a black spot at the base of the caudal fin. The spots on the latter are large and more numerous.

The specimens I obtained of both species are young. One of the *L. productus,* of eight and one-half inches in length, exhibits the persistent caudal *chorda dorsalis* with dermal margin, which has been observed by Prof. Wilder. It is nearly absorbed in a rather larger example.

Chrondrostei.—Scaphirhynchops platyrhynchus Raf.—Abundant in the Missouri. An individual taken at Fort Benton weighed forty-seven pounds. I secured its head.

[1] Proceed. Academy, Philadelphia, 1865, p. 86.

RECENT LITERATURE.

A JOURNAL OF A TOUR IN MAROCCO AND THE GREAT ATLAS.[1]—Naturalists, and especially botanists, cannot soon forget the delight with which they perused the volumes of the Himalaya Journals. Indeed there is a grace of style, a closeness of observation and an accuracy of statement in Sir Joseph Hooker's writings which claim the attention and interest even of the general reader. His account of his journey to Marocco, in 1871, has been anticipated with delight by all readers of his former travels, nor will they be disappointed when they take up the volume before us.

Owing to Sir Joseph Hooker's pressing engagements as Director of Kew Gardens and President of the Royal Society, there has been unavoidable delay in the publication of the journal; indeed, at his own request, Mr. John Ball, who accompanied him in the journey, completed the work after the first two chapters. No one, however, will regret this, for Mr. Ball is certainly a good writer and close observer, not hesitating to relieve his narrative now and then by humorous comments on men and things. It is stated by the authors that owing to the peculiar condition of Marocco (which it will be observed they spell with an *a*) no great change has probably occurred in that country since their visit, and hence the delay in publication is of less consequence than would usually be the case.

"The narrative now published is mainly founded on the journals kept by Sir J. Hooker and Mr. Ball, supplemented in some particulars by that of their fellow traveler, Mr. G. Maw."

The desire of the distinguished party was to penetrate the Atlas range and to determine some vexed points of geography while collecting the plants of this almost unknown region. Although provided with the order of the Sultan to allow them all possible privileges, they were constantly thwarted in their desires by the fanaticism and suspicions of local governors and petty chiefs. The Sultan's letter, it is true, did not appear to give very explicit directions, and to the mind of the reader, at least, leaves that sovereign open to the suspicion of chicanery: "On receiving this, you will send the English hakeem and his companions to the care of my slave, El Graoni, to whom I have sent orders what he is to do." Judging from after developments, the slave, who was a powerful chief, read freely between the lines. The party succeeded, however, on one occasion, in escaping from the surveillance of the guides and actually reaching the much-coveted snow. We quote the graphic account of this ascent:

"Much to our satisfaction the sheik now withdrew, committing us to the charge of an active but unarmed young Shelluh, with

[1] *Journal of a Tour in Marocco and the Great Atlas.* By Sir J. D. HOOKER and JOHN BALL. London, Macmillan & Co., 1878. $6.50.

strict injunctions to lead us as far as the snow, but not to allow us to proceed farther. It is hard to say whether the sheik and his people felt any real uneasiness as to the possibility of a casual encounter with natives of the Sous valley; but it was pretty clear that they had succeeded in frightening our attendants, as our Mogador men, usually so active and attentive, soon dropped behind and were not again seen till our return in the afternoon. We took the most direct course in the ascent, following a slight gully down which flowed a mere trickling rivulet, fed by the snows on the upper slope of the mountain, and pushed on rather fast with a view to get as high on the mountain as possible before the sun reached the meridian.

"Bearing in mind the great diversity in the vegetable population which is seen in Southern Spain (the high mountain region nearest to the great Atlas), where neighboring peaks of different mineral structure exhibit numerous quite distinct species, and very few identical features, and having found the flora of the lower valley to a great extent different from that of Ait Mesan, we confidently reckoned on obtaining still greater evidence of distinctness in that of the upper region. It was, therefore, with some surprise that, as we continued the ascent, we met, one after another, many of the peculiar species that we had first seen in the ascent from Arround to the Tagherot pass, and comparatively few not already familiar to us. For once, however, it must be owned that during part of this day, our emotions as botanists yielded to the interest that we felt in the near prospect of a peep into *terra incognita*. If but little had hitherto been known of the northern slopes of the Great Atlas from the reports of the few travelers who had viewed the range from the low country, or had attained its outer slopes, the southern side of the main chain remained a sealed book to the geographers, whose reliance on the vague reports of native informants has led them, like the chartographers of the middle ages, to fill up the blank space on their maps by representations utterly discordant and contradictory. * * Of the physical features of the country we could learn nothing.

"By the time we reached the lower skirts of a long snow slope that stretched upwards towards the summit of the mountain, the sun, which had now ascended nearly to the zenith, beat down upon us with intense rays, that drove some of the party to seek temporary shelter. The guide probably considering that he had done his day's work, and finding a narrow rim of shadow under an overhanging rock, lay down with his head screened from the blazing heat. Ball, who was suffering from a violent headache, also found a spot that gave partial shade. Hooker took advantage of the halt to push on at a steady pace that soon carried him beyond the reach of interference from the guide. When Ball felt able to resume the ascent, the guide sprung to his feet, and

for the first time became aware that one of the party was already too far ahead to be easily overtaken. He proceeded, by a series of unearthly yells and frantic gesticulations, to attempt to attract Hooker's attention, and urge him to return. When these demonstrations were found to be useless, and he perceived that Ball was also about to follow in the ascent, he commenced a fresh series of exclamations and pantomimic gestures, of which the burden seemed to be that if we went we were certain to be shot; but the same argument that was used with effect on the Tagherot pass—the gift of a silver coin—was so far successful that no attempt was made to arrest Ball's progress, and after ascending a few hundred feet higher, the unwilling guide gave up the attempt, and rested comfortably until he had an opportunity of rejoining Hooker in his descent. * * *

"Hooker reached the summit about 2 P. M., and was rejoined by Ball nearly half an hour later. Excepting some light fleecy cumuli floating over the low country to the north, at a lower level than the eye, the sky was cloudless; but in some directions a thin haze obscured the details of the vast panorama. Our first glance was inevitably directed towards the unknown region to the south, and there, at a distance of fifty or sixty miles, rose the range of Anti-Atlas, showing a wavy outline, with rounded summits, and no apparent deep depression, rising, as we estimated, to a height of from 9000 to 10,000 feet above the sea."

Full as the work is with graphic pictures, it is to the botanist, of course, that it will afford the most delight. Not only are plants described, but their habits and distribution are noted, as for instance when the authors speak of *Periploca græca* and *P. lævigata*. The latter is the single mainly western species, "This appears to be common in the Canary islands, and grows freely in the tract now visited by us to the north-west of Mogador. It has been found in abundance on some rocky islands near the coast of Sicily; but in spite of the silky hairs attached to the seeds, it has not spread itself to neighboring islands, nor to the Sicilian coast. It has been detected in two or three places in the south-east of Spain, and here and there in rocky places on the skirts of the desert in the interior of Algeria and Tunis. Finally, it was long ago found by Labillardière in one place on the coast of Syria. All this points to the former wide diffusion of a plant which no longer finds favorable conditions of existence, unless, perhaps, in the Canary islands. Its presence in the interior of North Africa may possibly date from the period when it grew near the coast of a great gulf opening to the Atlantic; but it is not easy to understand how it has held its ground in a climate so different from that of its natural home. This plant has inherited from a remote ancestor a habit which is now of no service to it. The young branches near the root twine round any adjacent support, but as they grow older they become stiff and straight, and

the taller specimens derive no adventitious support from this source."

A copious appendix at the end of the volume, which, by the way, is neatly illustrated, embodies, together with much other matter, valuable notes on the flora of Morocco and the Canaries, together with meteorological and geological information in a condensed form. We take pleasure in commending the work to our readers, feeling sure that it will meet with their approval.—*W. W. B.*

The Series of Animal Forms in Geological Time.[1]—In this work Prof. Gaudry brings together from his stores of palæontological knowledge the evidences of serial relation in time presented by various groups of *Mammalia*. Following in the steps of Kowalevsky (Palæontographica, 1873) and Cope (Journal Philadelphia Academy Sciences, 1874), he takes up the history of each portion of the skeleton separately, and although he does not exhaust the subject, he treats it more fully than either of the authors named. The volume is divided in correspondence to the orders of *Mammalia*, and in each division the characters of the skull and skeleton, of the feet and of the teeth are taken up successively. Prof. Gaudry's classification, it must be admitted, is somewhat antiquated, for he adopts the "orders" *Pachydermata* and *Solipeda*, including in the former the hogs. Under the *Marsupialia* he describes the interesting French genera of the *Creodonta*, giving excellent figures of their teeth, which are very welcome. He does not appear to have been acquainted with the researches of Cope on these animals published in 1875[2] in which it was shown that they cannot be referred with any probability to the marsupials. Under the head of *Pachydermata* an interesting discussion of the origin of the present dental type of the *Rhinocerida*æ is found, that part relating to the outer crests of the molars being apparently new. The portion relating to *Palæotherium* and *Lophiodon* is especially useful. Prof. Gaudry treats the *Amblypoda* lightly, the principal expositions of the characters of the order by American palæontologists not having probably come into his hands at the time of writing his book. The discussion of the teeth and feet of *Ruminantia* is especially full, and good figures of the parts of several genera little known in America are given. One of the best chapters is that on the *Carnivora*, where the gradations in the dental characteristics of the genera are clearly shown. The extinct *Quadrumana* of Europe are very well illustrated, including the genera of *Mesodonta*, found in France. The author admits the suggestion of Filhol, that the latter "presentent, comme les *Adapis*, des passages entre les lémuriens et les pachydermes" (p. 230); a position which we

[1] *Les Enchainements du Monde Animal dans les Temps Geologiques. Mammifers Tertiaires.* Par Albert Gaudry. Paris, Savy, 1878. 8vo.

[2] Proceedings Academy of Natural Sciences, Philadelphia, December.

think is quite indefensible. In this chapter Prof. Gaudry discusses the flints found by the Abbé Bourgeois in the Middle Miocene (Calcaires de Beauce) of Loir-et-Cher, concerning which opinions so differ. They are regarded as works of art by many archæologists, among whom are cited MM. de Vibraye, de Mortillet, de Quatrefages, Hamy, etc., and the figures given by Prof. Gaudry are certainly favorable to this view. The great antiquity of the horizon is opposed to the belief that they could be the work of human hands, for the Calcaires de Beauce represent a horizon not much above the Oregon beds of our White river formation. As Gaudry remarks, no species of Mammal of that period still exists; and he adds, "it is not probable that the cutters of those flints remained the same amid universal change." His concluding words are as follows: "If then it is to be shown that the flints of the Calcaire de Beauce, collected by the Abbé Bourgeois have been cut, the idea which presents itself most naturally to my mind is, that they were fashioned by the *Dryopithecus*."

As a popular and at the same time scientific exposition of the succession of Mammalian forms, as displayed by their structural details, this book has no rival. The author has been led, like most other thorough students, to adopt the doctrine of evolution, and some of his reasons are here clearly set forth. The work is distinguished for the excellence of its engravings and typography.

Ryder on the Mechanical Genesis of Tooth Forms.[1]—In the several articles relating to this subject Mr. Ryder has made a valuable contribution to the doctrine of evolution. He adopts the classification of teeth proposed by Cope, and endeavors to explain by mechanical laws the succession or phylogeny of the various existing dental types pointed out by the same author. The application of mechanical theory to this question is ingenious, and results in some very probable hypotheses. First among these is the supposed effect of lateral pressure in flattening conical cones or cusps so that their section becomes semicircular or crescentic. Another is the probable crowding of tubercles on each other by impact transverse to their direction, producing plicate structure. His conclusions may be stated more in detail, and are as follows:

1st. That in *Carnivora* and *Omnivora* the jaws were simply opened and closed during mastication without lateral movement of the mandible or lower jaw, and that the earliest and most constant type of tooth accompanied this movement; that is, that the tubercles or cusps composing the teeth do not to any extent depart from the short-rooted type with conical tubercles, styled by odontologists bunodont. That the distance apart of the series of molars of opposite sides, of both upper and lower series, was

[1] *On the Mechanical Genesis of Tooth Forms.* By John A. Ryder. Proceedings of the Academy Natural Sciences, Philadelphia, 1878, p. 45. Further notes on do. Loc. cit., 1879, p. 47.

approximately alike; that is, that in closing the jaws the external or buccal cusps of the upper series were brought exactly upon a line with those of the lower, not over them, as is the case in all *Herbivora* and to some extent in man. This condition he has called isognathism.

2d. That in the *Herbivora* the jaws were opened and closed in mastication with extensive lateral movement of the mandible; and that the teeth were by this greatly modified in respect of their tubercular constitution, the tubercles being of the type known as crescentic, giving us the long-rooted selenodont type of tooth. That in these the width of the jaw, or the distance apart of the upper series of molars of opposite sides of the head, greatly exceeds the same measurement in the mandible, which results in the external or buccal cusps of the upper series closing over and external to the buccal cusps of the lower series. This condition he has styled anisognathism.

3d. That in some *Rodentia and Proboscidea* the mandibles were moved in a backward and forward, or antero-posterior direction, which he has termed the reciprocating movement, with which there was also a corresponding tubercular modification, which he calls trichecodont—three tubercles forming transverse ridges, frequently obsolete, or greatly flattened transverse lamellæ, composed of elongated and united tubercles soldered together by a thick cementum layer. (Elephas). Isognathism is usually a characteristic of this subdivision.

4th. That in a subdivision including a part of *Rodentia* and *Proboscidea* (mastodon), the movement of the mandible was both reciprocating and lateral, with a still more complex type of dentition as a result, which he has styled ptychodont—enamel fluted and folded upon itself longitudinally and transversely. These jaws are usually anisognathous.

These observations, based upon investigations made not only upon the skulls but also upon the living animals, afford, he thinks, the key whereby to correctly interpret the morphological history of the teeth of the higher groups, especially when brought to bear on the interpretation of the teeth of the great number of herbivorous remains which the rocks have yielded in recent times as intermediate or antecedent forms.

The number of kinds of excursions made by the mandibular rami is limited by structural impediments, since a bar fixed at one end and free at the other, to which the mandible may be compared, is capable of but a few distinct movements. We find these to be essentially those mentioned in the definition of the four groups; few others are possible or conceivable. The first movement is the vibratory one in a vertical plane; the second is the vibratory movement in both the horizontal and vertical planes; the third is the vibration of the rami in an approximately horizontal plane, neither lateral nor vertical, but an antero-posterior

or reciprocating movement, parallel to the medial axis or line; the fourth is that which combines to a great extent the second and third. It is also to be observed that the lines described in most cases are not straight, but only approximately so, they being more or less curvilinear. With these four distinct types of mandibular movement there are as many distinct types of tooth-modifications, to which almost all the forms of teeth of Mammalia yet known may be referred. The bunodont type is that characteristic of group 1, and in which the tubercles have not been modified, because there have been no movements of a proper kind to produce the modifications in the enamel foldings as observed in the longitudinally or the transversely folded enamel crowns of the lophodonts (ridge or hill tooth). To this foregoing group 1 belong also all the haplodont type (simplest form) as observed in the toothed whales.

According to the doctrine of mechanical dental differentiation, the foldings of the enamel in the teeth of groups 2, 3 and 4, whether they be longitudinal or transverse, are due either to the lateral or reciprocating movement of the jaws. The sub-group, selenodonts—so called in consequence of the crescent-shaped foldings of the enamel of which the deer is a familiar example—is perhaps the most striking illustration of all. The characteristic crescent-shaped tubercles, the author thinks, have probably been evolved by a very slow process of flattening and bending outwards or inwards of the cornu of the tubercles, due to the strains exerted in masticating the tough woody food. The movement in this case being constantly in one direction, makes it still more probable that such has been the history of the process.

The incisors of many animals having been lost or hypertrophied either from the assumptions of their functions by other parts, as the lips, tongue or trunk, or by substitution of another function, as in the case of the tusks of the Proboscidians, it would seem that mechanical resistance has much to do with their special development, as is also seen in Rodents.

A summary of the foregoing views the author has stated as follows:

"1. That the earliest and simplest type of mammalian jaw-movement was that in which the mouth was simply opened and closed, without mandibular excursion, and co-existent with the simple haplodont or bunodont molar.

"2. That the development of the various kinds of excursive mandibular movement has apparently been progressive.

"3. That as the excursive movements have increased in complexity, there has been an apparent increase in the complexity of the enamel foldings, ridges and crests.

"4. From the fact that the foldings, etc., have apparently been modified in conformity to the ways in which the force used in mastication was exerted, it is concluded that the various modes

of crest and tubercular modification are related as effects to the diverse modes of mandibular movement.

"5. It is apparent from the facts presented throughout the context that the mandibular articulations, and correlatively the skull have probably been modified in shape by the movements made by the jaws and the forces exerted in executing them.

"6. From the fact that the incisor teeth are partially or entirely absent, or relegated to another function, in forms which have long prehensile tongues, mobile, prehensile lip or proboscides, it is held to be probable that such disappearance of the incisive dental elements is due to the assumption of their function by the prehensile organs indicated."

The bearing of these conclusions on the general doctrine of evolution is clear enough. The author of the papers reviewed has endeavored, and we think with much success, to solve in this field, the real question in hand, which is not so much the "survival of the fittest" (Darwinism), as the *origin of the fittest.* In so doing he has found it necessary to avail himself of the hypothesis of "acceleration and retardation," and of "use and effort;" views which have often found advocacy in the pages of this journal. We think that Mr. Ryder has supplied an important link in the chain of evidence which connects motion[1] as a cause, with structure as an effect, and we shall anticipate for him future success in this fertile field of inquiry.

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[1] See this journal, January, 1878.

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Nouvelles Recherches sur Prosopistoma. Par Drs. N. et E. Joly. Montpellier, 1876.

Descripcion Metamorfosis y costumbres de Una Especie Nueva del genero Siredon. Por José M. Velasco. Mexico, 1878 (? 1879).

Les Reptiles de l'Epoque Permienne aux Environs d'Autun, par Albert Gaudry. (Ext. Soc. Geol. de France, Dec., 1878.) 1879.

Description de deux Solens nouveaux par Lefèvre et Watelet. Bruxelles. No date.

Etude sur le genre Notidanus par E. Delfortrie. Soc. Linn. de Bordeaux, 1878.

Les Dunes Littorales de Golfe de Gascogne. Par M. E. Delfortrie. Soc. Linn. de Bordeaux, 1879.

GENERAL NOTES.

BOTANY.

THE MUTUAL RELATIONS BETWEEN FLOWERS AND THE INSECTS WHICH SERVE TO CROSS THEM.[1]—In 112 well illustrated octavo pages Dr. Müller has given us a very pleasantly-written account of the present state of our knowledge in this department of biology. Many of the facts and theories are by no means new, but many others appear in print here for the first time.

The writer shows that botany and zoölogy are more than mere "descriptive natural sciences" as they are even yet called, and that not the least of the good resulting from the theory of natural selection, advanced by Darwin, is the revival of an interest in biological studies—an interest which, excited a century ago by Réaumur, Roesel and Sprengel, had been entirely lost in the passion for systematic work which Linnæus inspired in his followers. Beginning with a description of the parts of a flower and their ordinary functions, he shows us how reproduction, the chief object of the flower, is accomplished, how the infinite variety of floral forms is produced from changes in the five fundamental organs of the flower—the calyx, corolla, stamens, ovary and nectar glands; how cross-fertilization tends to strengthen a series of descendants, and self-fertilization to weaken them; and how natural selection must preserve the former and render permanent such qualities as tend to secure crossing, while the latter will, in time, give place to them.[2] The probable course of development, from the lowest forms of life of those plants which are merely cellular, as the Algæ, mosses and liverworts, and still further of the vascular cryptogams and phænogams is well traced.

As regards their means of fertilization, plants are divided into two groups:

a. Gymnogamæ, including all plants which possess naked male cells capable of independent motion through the water to the female cell. This group contains all the sexual cryptogams, and is but slightly discussed by Dr. Müller.

b. Angiogamæ, including plants whose male cells are enclosed in a protecting cell wall, and are carried to the female cell by foreign agency. With this group, containing all the Phænogams, the present paper is chiefly concerned.

As agents for transferring the male cells or pollen of the Angiogamæ, we find water, wind, and various animals, as is

[1] *Die Wechselbeziehungen zwischen den Blumen und den ihre Kreuzung vermittelnden Insekten.* H. MULLER in Schenk's Handbuch der Botanik.

[2] It may be well to refer such readers as are interested in the discussion of this subject to an article by Rev. Geo. Henslow, in the *Popular Science Review* for January, 1879, where the figures by which Mr. Darwin proves the value of cross-fertilization, in his book on that subject, are made to show that after the first few generations there is a constant tendency towards equality between crossed and self-fertilized offspring, and where many instances of constant self-fertilization are collected.

well expressed in the terms *Hydrophilæ* (water-loving), *Anemophilæ* (wind-loving), and *Zoidiophilæ* (animal-loving), often applied to the different groups of Phænogams, according to the agency by which they are fertilized. Of the Hydrophilæ our common *Vallisneria spiralis* may serve as an example. The Anemophilæ may be subdivided into *Archispermæ* and *Metaspermæ*, represented respectively by the pine and the oak, the former possessing naked ovules and winged pollen-grains, the latter, ovules enclosed in a pistil and wingless pollen; and, as indicated by the names, there is much reason to believe that the former represent an earlier stage in the development of plants than the latter. The Zoidiophilæ are divided into three groups, *Malacophilæ*, fertilized by snails, *Entomophilæ*, fertilized by insects, and *Ornithophilæ*, fertilized by birds. The first and last are represented by comparatively few species, by far the greatest number being entomophilous.

The writer gives a brief but clear account of cleistogamy and heterogymy, which Mr. Darwin has so well treated in his work on Different Forms of Flowers in Plants of the same Species, and gives many illustrations of the adaptation of certain flowers to the visits of certain groups of insects, as outlined in the NATURALIST for April, and of the various contrivances by which insects are enabled to obtain food from flowers of different forms. One of the most interesting of these is that of a Brazilian species of *Nemognatha* (a beetle), the maxillæ of which are developed to a length of twelve mm., exceeding the length of the insect's body and resembling the similarly-formed proboscis of butterflies. Very interesting, too, is the tongue of one of the higher bees, for when a bee is sucking nectar from a flower the fluid must necessarily rise the entire length of the tongue before reaching the organs of taste, and were it sucked up and then found unsatisfactory that which remains adhering to the whorls of hairs with which the tongue is provided would contaminate the nectar of the next flower visited, or at least destroy its proper taste. To avoid this difficulty the tongue of the higher bees is provided with a capillary tube in place of the chitinous rod found in that of the lower bees, and this communicates at its base with the taste organs, and opens into a spoon-shaped enlargement at the distal end of the tongue. On visiting a flower the bee thrusts this spoon-shaped organ into the nectar, and a portion immediately rises through the tube by capillary attraction, but if not of pleasing taste it is readily expelled before any has become entangled in the hairs surrounding the tongue.

The paper is, throughout, one of exceeding interest, and it is to be wished that every student of biology, and especially every young student, might read it.—*Wm. Trelease.*

BOTANICAL NEWS.—In the *Bulletin* of the Torrey Botanical Club for April, C. F. Austin, in notes on Hepaticology, describes

new liverworts from Florida, South Carolina and California, and several new exotic species. Prof. Eaton continues his notes on new or little known ferns of the United States.——Trimen's *Journal of Botany*, for May, contains A. W. Bennett's Polygalæ Americanæ novæ vel parum cognitæ.——Among other articles in Caruel's *New Italian Botanical Journal*, is one by F. Sestini on the action of the vapor of different substances in the seed during germination.——Three eminent botanists have recently died, Prof. G. L. Reichenbach, of Dresden, aged 86; Dr. F. M. Ascherson, at Berlin, aged 81; also Prof. Griesebach, who died at Göttingen, May 13th.

ZOÖLOGY.[1]

Strange Habitat of a Barnacle on a Gar Pike.—I have recently received a barnacle from Mr. Jos. Wilcox, of Philadelphia, which he obtained from the scales of a gar in Hernando county, Florida. The specimens are small; the largest measures eight millimeters in carino-rostral diameter, about seven mm. in the other, the smaller specimen seven mm. in the first, and six mm. in the other direction. As nearly as I can make out, it is very near if not identical with *Platylepas decorata* Darw., though this species seems hitherto to have been recorded as coming from the Pacific only; the Florida locality is of considerable interest, therefore, as extending the range of the species. The fish from which the specimens were obtained was found in brackish water, and therefore agreeing in the nature of its habitat with the probable conditions of the water in the Gambia river, Africa, where the *P. bissexlobata* has been found on the manatee. There are no pores in the parietes, the midribs of the compartments were well developed, and in one specimen the membranous basis was as convex as the shell, in the other not quite as convex. The basal membrane seems to be reflected up over the parietes to near the aperture and also to extend some way outwards from the attached margin of the compartments, as if to afford a more extensive attachment to the fish.

I have been unable to find any record of the occurrence of these and kindred forms on the gar, but it would be well adapted to them, as their scales would afford secure attachment.

It would be of interest to know whether the creature's shell left a depression in the scales of the fish equal to the convexity of the basal membrane. Mr. Darwin observes in regard to other barnacles which attach themselves to turtles, whales and sharks, in effect, that the growth of the shell of the parasite into the tissues of its host is due to a force similar to that which impels the root of a tree through hard compacted soil.—*John A. Ryder.*

[1]The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

ANIMAL MUSIC (AM. NAT., April, 1879).—The song of the chickadee is given in but two notes, although the name is derived from five syllables—chick-a-dee-dee-dee. Mr. Nuttall was a close observer of the song of birds, but contented himself with noting only the syllabism. The music of birds differs in form and pitch, as in that of the Baltimore oriole or hang-nest, given by me in the AMERICAN NATURALIST (with the note of the bull-frog, Jan., 1872, p. 234), as compared with that cited by Mr. Clark (April, 1879, p. 222). Gardiner gives nine examples of the song of the English throstle in five keys (Music of Nature, pp. 59, 140, 162, 225, 344, 454), fourteen of the European blackbird in four keys (pp. 59, 76, 130, 140, 162, 434), and others equally scattered and difficult to compare.—*S. S. Haldeman.*

SHEDDING OF THE TRACHEÆ IN THE MOLTING OF INSECTS.—While dissecting out the spiracles from the last casting of the larval skin of one of our common silk moths (*B. mori*), I remarked that parts of the trachea remained attached to them. To confirm this observation, I opened a number of cocoons of the ordinary silk worm, which chanced to be in my possession, and placing the shriveled cast skins found in them in potash water, left them for several days to soak and soften. I then succeeded in spreading them out sufficiently to exhibit, attached to each spiracle, a great bunch of tracheal vessels of varying sizes lying parallel, as though they had been drawn out through single openings in the body of the larva. While I cannot be sure that all the finer branches of this tracheal system were present in these bunches, the larger tubes certainly were, and the smaller may readily have been detached and lost in the processes of preparation or broken off and left as dead matter in the body. The fact is clear that in the shedding of the last larval skin at least the tracheal vessels remain attached and are removed with it. When we think of the trachea as portions of the ectoderm or outer layer or skin of the insect, this coincident removal seems only natural and to be expected; but the fact is none the less curious, nor its process more easy to comprehend. Are these vessels with all their ramifications withdrawn from the interior of the larva before the formation of the pupal skin with its spiracles and trachea? and if so, is there not a period during which the insect is without effective respiratory organs.

When the pupa changes into the imago, the same fact is observed. Here also the trachea, of much smaller proportions than in the former case, are found within the empty pupa skin. When does the imago as such begin to breathe with its own proper organs? When it bursts its mummy-like cerements and shakes out its new found wings in this fourth condition of its existence, is there a new birth in this respect also, that it begins at this moment to breathe in its higher life?[1]—*Edward Potts.*

[1] This molting of the tracheæ has been noticed by me in the larva of the humble-bees. See Proceedings Boston Soc. Nat. Hist., x, 283, 1866.—*A. S. P., Jr.*

TWO CHRYSALIDS IN THE SAME COCOON.—Another fact noticed in the examination of the cocoons just referred to surprised me. The first opened, a perforated one, contained two cast larval skins, an empty pupa case and a perfect pupa. Two others, also perforated, in this collection of seventeen, contained each two cast skins and two pupa cases. The situation was puzzling. One other cocoon, like the three former, of unusual size, remained perfect. I cut into it and found two cast larval skins and two perfect pupæ. I could come to no other conclusion than that in each of these four out of seventeen cases, *two worms* had worked together and in partnership spun the cocoons. The proportion in numbers of these abnormal instances is probably altogether fictitious, as the greater size may have invited their selection as specimens. Desirous to obtain some confirmation of this singular state of things, I inquired of a very intelligent Spanish gentleman formerly engaged in silk raising, and learned that while he could not remember having seen two worms actually engaged in forming the same cocoon, he had frequently observed two climbing simultaneously into the same twig and was very ready to believe that when once they had attached their threads to spin, neither would give way, and they thus became enveloped in the same toils. It was therefore his idea that it was rivalry in the search of a favorable location rather than any anticipatory sense of sexual attraction which had led them into these intimate relations. It is much to be hoped that the attention of other observers may during the coming season be directed to a further examination of the above facts, which, so far, I have been unable to find recorded.—*Edward Potts.*

NEW DEEP-SEA FISHES.—The researches conducted by the United States Fish Commission under the direction of Professor Baird, has resulted in the addition of a large number of species to the fauna of the eastern coast of our country. These have been mostly described by Messrs. G. B. Goode and T. H. Bean, whose full and careful diagnoses are valuable additions to ichthyology. At present we notice only those obtained at great depths, since these claim especial interest of the present time. The earliest of these discoveries was that of a new *Chimæra* from near the La Have Bank (Lat. 42° 40′ N.), which was named by Professor Gill *C. plumbea.* The Arctic *Reinhardtius hippoglossoides* has been found at depths below 200 fathoms in the same latitude with the *Macrurus rupestris.* A new *Macrurus* from deep water off Cape Ann is called *M. bairdi.* New species of *Phycis* and *Haloporphyrus* also represent the *Anacanthini.* Several specimens of *Alepidosaurus ferox* have been taken off the same coast between lats. 41° and 44° at depths of from 200 to 400 fathoms.

The most important additions to deep-sea ichthyology ever made is the collection of the *Challenger* expedition, upon which a preliminary report was published about a year ago by Dr.

Günther. As with the American collections, no division receives greater accessions than the *Anacanthini*. Not less than six new genera of this group are described by Günther, four of which he places in the *Ophidiidæ*. Ten species are added to the genus *Coryphænoides*. The *Scopelidæ* prove to be equally characteristic of great depths, fifteen species and three genera being reported as new. Perhaps the most interesting novelties are five new species of *Alepocephalidæ*, which belong to four genera, of which three are new. The total number of species described by Günther is sixty-one.

To Prevent Grease from Injuring the Plumage of Birds.—I have received the following letter which speaks for itself.—*Elliott Coues.*

Clinton, Conn., April 12, 1879.

Dr. Coues:

Dear Sir:—In your Field Ornithology you speak somewhat despairingly of preventing the oil from injuring the plumage of fat birds, and I write to tell you of an experiment that I have tried, and which I believe is a success. A month since I put up a goosander whose skin was thick and very oily. Taking off the leaves of fat, my next thought was of how to prevent the saturation of the feathers, and I hit upon this experiment. Being a dentist and accustomed to the use of absorbents, I took a piece of spunk, of which I enclose a sample, cut it of an oval shape and large enough to reach pretty well up on the side of the tow body, pinned the edge smoothly to it, and as it is of a uniform thickness, it made a good surface for the skin to lie against.

This specimen has been in my laboratory all the time during these weeks, exposed night and day to the ordinary temperature of a house heated by a furnace, and shows not in the slightest degree any appearance of oil, while another specimen with a very similar skin is completely saturated beneath.

I take the liberty to write on this subject as it may lead to a satisfactory solution of the problem, how to keep the oil from soiling the plumage in fat birds.

Very truly yours,

A. H. Stevens, Clinton, Conn.

Another Siredon.—M. Velasco has recently published in the Memoirs of the Mexican Society of Natural History for 1878, a description of a species of *Amblystoma* and its metamorphoses, under the name of *Siredon tigrinus*, which is found in lake Santa Isabel, in the valley of Mexico. M. Velasco names the species as new, but we cannot perceive that it is different from the yellow-spotted varieties of the *Amblystoma mavortium* of Baird. The metamorphoses of Mexican specimens of this species have been observed by Duméril, and Sumichrast has sent specimens of the same from the elevated regions of Vera Cruz. M. Velasco gives

us the most southern locality yet known, and illustrates its characters with some very good figures. Will not some of the naturalists of Mexico give us an account of the metamorphoses of the *real Siredon*, the *S. mexicanus*, from the city of Mexico? No one has yet described it, if any there be.—*E. D. Cope.*

LOTA MACULOSA IN THE SUSQUEHANNA RIVER.—About twenty years ago Mr. J. M. M. Gernerd caught a specimen of this fish in a net at Muncy, Lycoming county, Penna. He preserved it in his collection and recently sent it to Philadelphia. It is about a foot long. Mr. Gernerd says that he has fished a great deal, but has never seen another specimen. It has not been previously recorded from the Susquehanna river.—*E. D. Cope.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The paper following that of Dr. Topinard, in the *Bulletin* of the Société d'Anthropologie de Paris for 1878, pp. 66–92, is by Dr. Paul Broca, the distinguished anatomist, upon the indices of breadth in the scapula of man, the apes, and the series of mammals. Three tables of indices close the communication. To M. Broca, perhaps, more than to any other anatomist living or dead, we are indebted for the application of rigorous methods and instruments of precision to various parts of the skeleton, which are likely to yield precious results in deciding the exact place of man in nature.

On page 104, M. Gustave Le Bon discusses the inequality of the corresponding regions of the cranium. The measures were taken on 300 skulls from different series in the collection of the Anthropological museum. Long ago students inquired whether the two hemispheres of the brain was equal, and Bichat considered that a default of symmetry was accompanied by a lack of rectitude in judgment. The autopsy of that illustrious anatomist, whose skull was exceedingly irregular, shows what a poor foundation we have for such a theory. In man most of the organs are more developed on the right side than on the left; but taking into consideration that the left portion of the brain presides over the functions of the right side of the body, we might suppose, *a priori*, that it is the left hemisphere of the brain which should be the most developed. Upon the 287 skulls that I have measured, in taking for a starting point the vertical plane passing through the external occipital protuberance and the prolongation of the median suture of the nasal bone, the following results obtained:

Skulls where the right side predominates	125
" " " left " "	111
" " " different bones are unequal, but whose inequalities are compensatory	51
	287

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

The foregoing observations demonstrate that the cranium, and therefore probably the brain whose form it reproduces, presents a lack of symmetry which is not of the same character for each of its parts.

On page 121, Dr. Le Bon describes a very simple anthropometric instrument, which he calls the pocket cephalometer, or compass of co-ordinates, designed to obtain very rapidly the different diameters, angles, and profiles of the head, and to reproduce in relief any solid figure whatever. A description of this instrument without drawings would hardly define it; we must therefore refer our readers to the paper of Dr. Le Bon.

On page 161, Dr. Thulié gives an account of the autopsy of Louis Asseline, a member of the Société d'Anthropologie and of the Société d'Autopsie Mutuelle. Asseline was 49 years old when he died. In politics, he was a republican; in philosophy, a materialist. After his education was finished, he came to Paris, where he contributed more than all others towards propagating those ideas which resulted in the overturning of the empire. He was the founder and patron of several radical journals, and was frequently imprisoned for his writings. He was also in political life several times.

Asseline was a member of the Société d'Autopsie, composed of individuals who believe that the study of the brain of a man whom we have known, not only through his works, but in his character and faculties, would contribute to the advancement of science. The first subject of mutual autopsy was Jules Asséza, who, by the way, did not derive much benefit from the mutual clause in the society's constitution. The second was M Asseline, whose autopsy occurred 39 hours after his decease. The brain weighed 1.468 grammes, which may be compared with Broca's table of means:

From 31 to 40 years.....1.404 grammes.
From 41 to 50 years.....1.403 "

Since Asseline was 49 years old, his brain-weight was considerably above the mean. The convolutions are large and thick. M. Broca on examining the brain, said "Ce n'est pas un cerveau fin, les circonvolutions sont épaisses, presque grossiéres." A remarkable fact, since that which characterized the intelligence of M. Asseline was an exquisite finesse pushed even to subtlety. There occurs upon this brain the *calotte*, regarded as a sign of inferiority by Gratiolet. Among the apes, indeed, the parieto-occipital fissure is profound; on the gorilla only M. Broca has observed this fissure to be deep on one side and superficial upon the other. This fissure is frequently deep in woman, as well as in some men of known intellectual mediocrity. In the brain of Asseline the *plis de passage* are profound, especially upon the left. This sign of inferiority should be studied; and we have a right to demand in the presence of this brain whose anterior parts

are so developed and which correspond to eminent intellectual faculties, if the development of the *plis de passage* does not correspond with secondary faculties. The cranial calotte is extremely thin. It is not a senile regression. The cerebral depressions and the vascular furrows are very marked, as if the internal table had been thinned by the enlarging of the brain. The frontal suture is not entirely ossified; it is less so than the parieto-occipital suture which is not entirely closed. There exists a certain asymmetry in the osseous vault; the frontal eminence on the right side is more prominent than on the left. A more extended account of the investigation is promised in future.

On page 173, M. Maurel describes the pre-historic man of Guiana, and on page 186, the same author presents an anthropological and ethnographical study of two tribes of Indians, the Aracouyennes and the Galibis, living on the river Maroni, Guiana. On page 230, Dr. Broca speaks of the skulls and objects of industry found by M. Bert, Thiahuanuco, Peru. Dr. Maurel presents a communication, pp. 260 to 269 upon the frequency of dental caries among the Galibi Indians and their offsprings of mixed blood with the blacks.

The first number of Vol. III, Proceedings of the Davenport Academy of Natural Sciences, contains a very full report on the condition and progress of the institution during the year 1878. In the address of the retiring president, Dr. Farquharson, we have a review of the results attained concerning the celebrated inscribed tablets and the still more remarkable elephant pipe. With regard to the tablets the doctor remarks: "If there are now any doubters of the authenticity of these 'precious monuments,' as M. Lucien Adam is pleased to call them, they are silent, either from their doubts having been dispelled by the accumulation of material evidence, or it may be that they deem us so incorrigible in the continued fabrication of these relics that remonstrance would be wasted on us."

The academy has taken the lead in another branch of anthropology, which might be called the natural history of the heart or affections, and elected a lady, Mrs. Mary L. D. Putnam, to the presidential office for the ensuing year. Dr. Parry in making the nomination said: "It is quite unnecessary to explain to any here present that the actual success and present prosperity of the academy has been coincident with the interest taken in it by woman. The very ground beneath our feet is the spontaneous gift of a generous woman."

Dr. Edmund Andrews contributes to the Transactions of the Wisconsin Academy, a paper on the literature and religion of the mound-builders, in which he takes the ground that they are not extinct, as popularly supposed, but still exist among our Indian tribes.

In the same volume Dr. C. R. Hoy gives us a discussion upon

the method by which the aborigines manufactured copper implements. The doctor takes the ground that none of these implements were cast, since the moulds were too difficult of management for the intelligence of American savages. "Copper is a refractory metal which melts at 2200 to 2600 degrees, a temperature that can be reached only in a furnace, assisted by some form of coal and an artificial blast. It is, when melted, thick and pasty, and without the addition of some other metal will not run in the cavities and sinuosities of the mould. A majority of the copper implements found have specks or points of pure silver over their surfaces; now one single speck of pure silver, visible even with the microscope, is positive evidence that the specimen was never melted." Dr. Hoy then proceeded to give his views of the methods of savage metallurgy. The Indians used fire in their mining operations. The vein rock was made hot by building a fire on or against it. Then by dashing water on the heated mass the rock would be fractured and removed, leaving ragged masses of copper exposed, which would also be softened so that it could be beaten into shape. When the metal became hard by pounding, it was again heated and plunged into water; for copper is, in this respect, the opposite of steel. In this way copper was fashioned simply by pounding.

In addition to the hammering process, cylindrical articles were evidently rolled between two flat rocks. Some of those implements that are supposed to have been cast were probably swedged; that is, a matrix was excavated in stone, into which the rudely fashioned copper was placed, and then by repeated blows the article was made to assume the exact shape of the mould. Besides this swedging process, Dr. Hoy is persuaded that in a few instances a complete mould was wrought out in halves on the face of two flat stones, so that by placing a suitable piece of copper between them and giving it repeated heavy blows the metal was made to fill the mould accurately. In order to test the matter the doctor constructed a mould of this description and was able to make a beautiful axe.

In the same volume of the Transactions, Dr. J. M. de Hart discusses the antiquities and platycnemism of the Mound-builders of Wisconsin.

Mr. Lester F. Ward sends us a pamphlet printed by Edward Stern & Co., of Philadelphia, containing his papers on Haeckel's Genesis of Man, which appeared in the April, May and July numbers of the *Penn Monthly* for 1877. As this celebrated work of the author has not yet been translated into English, Mr. Ward has done a useful thing in presenting the views of Prof. Haeckel in a clear and succinct manner.

GEOLOGY AND PALÆONTOLOGY.

A Peculiar Cave in Utah.—The Oquirrh range of mountains, in Utah, extends northward as far as Great Salt lake and borders

the lake for a short distance along the south-east shore. Near Lake Point, as in many other places, old lake beaches or "benches" can be traced on the side of the mountain, the highest having an altitude of about 900 feet. In some places four distinct ones can be seen. On one of the benches a cave opens into the carboniferous limestone, of which the mountain is mostly composed. This cave, known as Clinton's cave, was first brought into public notice by Mr. G. K. Gilbert,[1] who described it and explained the probable mode of its formation. Later Dr. A. S. Packard, Jr., published an interesting account[2] of several species of cave animals which he found living there. He also determined its geological age to be most probably the Quaternary. Having recently visited it and made a discovery which seems to throw some light on the mode of its formation and its age, I am enabled to verify their conclusions and to give further particulars.

The strata forming the mountain are here uplifted into nearly a vertical position. One stratum having a thickness of ten or twelve feet, seems to have been composed of a softer material than the adjacent ones. When the water of the lake stood at about the level of the bench on which the cave is now situated, the action of the waves in breaking upon the rocky shore gradually wore away this soft stratum until a long narrow crevice had been excavated into the side of the mountain. Similar action is going on to-day on the coast of New England, where dykes of porphyry are exposed to the direct action of sea-waves, the porphyry being worn away faster than the wall-rock.

After thus cutting horizontally to a depth of over 300 feet, and vertically to the surface of the slope for the whole distance, the lake evidently subsided sufficiently to allow of an accumulation of coarse sediment which was washed from the slope above, filling the crevice, and which was cemented into a conglomerate by carbonate of lime. Then the lake rose again to the level of this bench and dug its way into the conglomerate; but instead of cutting upward to the surface it tunneled horizontally as far as before and formed a cave, the height of which to the roof is nowhere more than twenty-five or thirty feet. The width varies from about twelve feet at the mouth to three feet at the innermost extremity.

An indication that this is the probable mode of its formation is afforded by the discovery to which I previously referred. While in Utah during the past summer, I visited the cave with Dr. Packard for the purpose of more fully investigating its fauna. The floor is composed mainly of earthy materials with an occasional layer of marl, in which Dr. Packard found several species

[1] Report on the Geology of Portions of Nevada, Utah, &c. G. K. Gilbert, A.M. Wheeler's Report, Vol. III, p. 98.

[2] On a New Cave Fauna in Utah, by A. S. Packard, Jr., M.D. Bulletin of U. S. Geol. and Geog. Survey, F. V. Hayden, U. S. Geologist-in-charge. Vol. III, No. 1.

of fresh-water shells. Several large masses of the conglomerate which forms the roof have fallen to the floor. While examining one which seemed to have fallen very recently, as it was not imbedded in the earth, I found enclosed in the rock, a land shell which has kindly been identified by Mr. W. G. Binney as *Patula strigosa* var. *Haydeni*. Further search failed to bring to light other specimens.

The great thickness of the conglomerate above the position of the shell precludes the idea that the filling took place at a very recent period. The same species is now found living in abundance in the vicinity of the lake. Its presence as a fossil undoubtedly proves the formation to belong to the Quaternary.

The discovery seems to be of interest on another account. Although the conditions of life must have been much varied since the deposit of the specimen in the conglomerate, the species retains, at the present time, even its varietal markings in great distinctness, a further evidence that all groups are not equally affected by climatic changes.—*Leslie A. Lee.*

The Bahna Basin.—M. Stephanesco, of Bucharest, has communicated to the Geological Society of France a description of the geology of the region of the Iron Gate of the Danube, on the extreme west of Roumania. Azoic beds are extensively developed on this part of the Danube, which are overlaid at one point by a band of Cambrian, which crosses the river below the gates. Lower down, a Tertiary formation appears, resting partly on the Azoic and partly on some secondary beds. Above the gates the Bahna creek enters from the north, after traversing a valley in which is situated the town of that name. This valley is excavated in upper and middle Miocene marine beds, which themselves form a synclinal series, with the opposing dips of 45° separated by a central fracture. M. Stephanesco points out that the relations of these beds, lying as they do directly on the Azoic, is similar to that seen in the basins of Vienna, Bordeaux, Dax and that of the north of Italy.

A New Anchitherium.—At a recent meeting of the Philadelphia Academy, Prof. Cope exhibited crania of three species of *Anchitherium* from the Truckee beds of Oregon, one of which he regarded as new to science, and named, on account of its superior size, *A. præstans*. It is the largest species yet found in America, and exhibits the typical characters of the genus. On the posterior border of the superior molars there is a trihedral tubercle in front of the elevated posterior cingulum, but the anterior cingulum does not rise into a tubercle, nor is there an accessory tubercle near it. The internal lobes of the crown are closely connected with the median lobes. External ribs and cingulum prominent; enamel smooth. The side of the face is concave, and there is a lachrymal fossa. The anterior border of the orbit

marks the middle of the last molar tooth. Length of molar series, .118 m.; of true molars, .050; length anterior to molars, .061; width between last molars, .040; diameters of crown of second true molar, fore and aft, .017, transverse, .022; length of tibia, .285; of metacarpal, .221.

GEOGRAPHY AND TRAVELS.[1]

GEOGRAPHICAL PROFESSORSHIPS. — The Council of the Royal Geographical Society have presented a Memorial to the Oxford and Cambridge University Commissioners urging the importance of establishing Geographical Professorships. Although there is no such chair existing in any American university, and although it may be as well said of America as of England, that "there are few countries in which a high order of geographical teaching is so little encouraged," the importance of such knowledge is recognized here, and the popular interest in scientific exploration is rapidly extending. It may be well, therefore, to call the attention of our educational authorities, especially those of our new and magnificently endowed universities, such as the Johns Hopkins and the Lehigh to this address. It is given in full in the "Proceedings" of the society for April last.

The Council include in the word Geography "a compendious treatment of all the prominent conditions of a country, such as its climate, configuration, minerals, plants and animals, as well as its human inhabitants; the latter in respect not only to their race, but also to their present and past history, so far as it is intimately connected with the peculiarities of the land they inhabit." * * * * * "Among the many classes of problems that fall under these heads, it is sufficient to specify two. The one deals with the reciprocal influence of man and his surroundings, showing on the one hand the influence of external nature on race, commercial development and sociology, and, on the other, the influence of man on nature, in the clearing of forests, cultivation and drainage of the soil, introduction of new plants and domestic animals, and the like. The other problem deals with the inferences that may be drawn from the present distribution of plants and animals, in respect to the configuration of the surface of the earth in ancient times. Thus we see that the mutual relation of the objects of the different sciences is the subject of a science in itself, so that scientific geography may be defined as the study of local correlations.

"Geography thus defined does not tend in any degree to supersede the special cultivation of the separate sciences, but rather to intensify the interest already felt in each of them, by establishing connections which would otherwise be unobserved. It is through geography alone that physical, historical and political conditions are seen to be linked closely together; and it is thus that geog-

[1] Edited by ELLIS H. YARNALL, Philadelphia.

raphy claims the position of a science distinct from the rest, and of singular practical importance."

The Council also mention that in France the State has endowed seven chairs of geography besides providing instruction of a high class in the Lycées. Seven of the German universities are also provided with professors of the science, and there are three chairs in Switzerland. "The literary results of German travel at the present day seem to show that the educational advantages which are attainable in Germany have borne fruit in developing and directing the powers of observation in German travelers."

"A copious collection of maps, models, pictures and ethnological illustrations of the various lands which are the theatres of historical study, would gradually accumulate under the charge of a professor of geography, and would enable him to illustrate their configuration and scenery as well as the social character of their inhabitants with a fullness that no ordinary teacher could hope to rival. Such illustrations, it may be remarked, are consistent with the general tendency of modern instruction."

GEOGRAPHICAL NEWS.—The *Nature* states that a large amount of material for arriving at some approximately correct notion of the mean depth of the sea having been accumulated in recent years, Dr. Krümmel has lately attempted this. Soundings were wanting for the Antarctic and a part of the North Polar sea, *i. e.*, about 475,000 square miles, or seven per cent. of the entire sea surface, so that he gives his estimate only as a closer approximation. He estimates then the mean depth of the sea as 1,877 fathoms, or 3,432 metres, or 0.4624 geographical mile. It was natural to compare the mean height of dry land above the sea-level. Humboldt's estimate of 308 metres is regarded as quite out of date. Leipoldt has since estimated the mean height of Europe as 300 metres. Accepting this number for Europe, 500 for Asia and Africa, 330 for America, and 250 for Australia, Dr. Krümmel obtains the mean of 420 metres, or 0.0566 mile. The surface ratio of land to water being considered 1 : 2.75, the volume of all dry land above the sea-level is inferred to be 140,086 cubic miles, and the volume of the sea 3,138,000 cubic miles. Thus the ratio of the volumes of land and water is 1 : 22.4. That is, the continents, so far as they are above the sea-level, might be contained 22.4 times over in the sea-basin. Reckoning, however, the mass of solid land from the level of the sea-bottom the former would be contained only 2.443 times in the sea space. Dr. Krümmel also compares the masses (taking recent data); he finds that of the sea 3,229,700 cubic miles, and that of the solid land 3,211,310 (a small difference). If the specific gravity of the land were raised merely from 2.5 to 2.51432, we should thus have perfect equilibrium. Such equilibrium is probably the fact.

Col. Prejevalsky started on his Central Asian journey on the 1st of February last, Ensigns Eklon and Roborovsky and two

subordinates accompanying him. At Kuldja he will be joined by the same interpreters as were with him on his last journey, and at Zaissan by five cossacks. From here the expedition will start with thirty camels and some horses for Hami and Suh-chau, and thence proceed to the Kansu mountains. The party will next make for Lhassa by the usual route, and by February, 1880, hope to reach the Himalayas by way of the Brahmapootra river. Returning then to Lhassa he will visit Khotan, Kashgar and cross the intervening plateau to Russian Khokand. The journey is to occupy two years. He has been most fully equipped for this arduous task, the Russian Geographical Society having contributed 20,000 roubles. If he can but accomplish a third of his programme, he will have done a great service to geography.

Friedländer & Son, of Berlin, have recently commenced the publication, every two weeks, of a journal, *Naturæ Novitates*, which contains a fortnightly bibliographical list of current literature in all languages in the various departments of science.

The Royal Geographical Society has undertaken to organize a uniform system of spelling the names of places throughout the globe. A commencement has been made with Indian names. After these are tabulated and revised the society propose to turn their attention to African names. They hope finally to establish a universal set of rules applicable to all parts of the world.

We learn from the *Academy* that a Norwegian captain named Bjerkan spent the winter of 1876–7 at Möller bay, on the west side of Novaya Zemlya. His journal, containing observations from October 4th to June 11th of the temperature of the air and sea, and the direction of the winds, has been published. These records show a decided maximum of temperature in January 4°.4 F. above the means of either December or February. This peculiarity is also noticeable, says the *Academy*, in all the existing records from Novaya Zemlya and in the Austrian observations on Franz Joseph Land, and is therefore not confined to the period of Capt. Bjerkan's stay. This high temperature was accompanied by prevalent southerly winds, but the absence of barometrical observations makes it impossible to say whether these winds were due to the passage of cyclones to the northward of the station in the month of January.

A small scientific expedition left Denmark in April of this year to explore portions of the coast of Greenland, their object being chiefly to examine the fiords between the Danish colonies of Holsteinborg and Egedesminde. Excursions are also to be made into the unknown regions of the interior, and scientific observations of various kinds will be taken.

The Church Missionary Society (London) have published two large wall maps of Africa for the use of lecturers. One exhibits the whole continent and the other the equatorial lake district.

A new edition of the Library Map of Africa, scale 1 : 5,977,382,

prepared by Keith Johnston, F.R.G.S., is published by Stanford (London).

A new map of Africa by the same editor, on a smaller scale, 1 : 8,420,000 has also been published by W. & A. K. Johnston (Edinburgh).

MICROSCOPY.[1]

American Society of Microscopists.—The local committee at Buffalo have secured the use of the "Central School Building" for the sessions of this society at its meeting in that city in August. The headquarters of the officers will be at the Tifft House, and local and general arrangements are being made which it is believed will be fully adequate and satisfactory. Excursion fares upon the railways and reduced hotel rates have been promised, and private hospitality will be tendered when desired. A soiree will be given under the auspices of the local microscopical society. The provisional constitution adopted at the Indianapolis meeting will come up for amendment and adoption, and all microscopists of the country are cordially invited to attend and participate in the perfecting of a permanent organization. Circulars giving full information in regard to the plans for the meeting can be obtained by addressing the secretary of the society, Dr. Henry Jameson, of Indianapolis, Indiana, or the secretary of the local committee, Mr. James W. Ward, of Buffalo, N. Y.

Royal Microscopical Society.—With an evident desire to share its prosperity with others, this society is renewing and extending its efforts to make itself a center of influence in the cultivation of microscopical science throughout the world. Its journal, under the honorary editorship of Mr. Frank Crisp, LL.B., one of the secretaries of the society, has become a superb magazine of microscopical science. By a recent action of the society fifteen honorary fellows were elected, including Dr. J. Leidy, of Philadelphia. Nearly seventy societies, in different parts of the world, were also designated, whose presidents for the time being should be ex-officio fellows of the society. As this arrangement includes the honorary distribution of the "Journal," it is a very generous as well as very judicious action. The societies in the United States included in this arrangement are the American Academy of Arts and Sciences, of Boston, the Boston Society of Natural History, the State Microscopical Society of Illinois, the New York Academy of Sciences, the New York Microscopical Society, the Philadelphia Academy of Natural Sciences, the San Francisco Microscopical Society and the Troy Scientific Association.

New York Microscopical Society.—This society has removed to its new rooms at No. 239 Fourth avenue, near Nineteenth street, where it will meet on the first and third Friday evenings

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

of each month, except July and August. It is also having excursions during the summer, after the manner of the Queckett Club.

THE PROPAGATION OF CLUSTER-CUPS.—Dr. M. C. Cooke, in his "Introduction to the Study of Microscopic Fungi," calls attention to the difficulty of accounting for the appearance of the cluster-cups (*Aecidiacei*) bursting through the cuticle of the leaves of the plants on which they are found. The question is as to the manner in which their spores reach the interior of the leaf where they germinate. It certainly cannot be by way of the stomata, for these are too small, nor would this account for the preservation of the spores until the succeeding year. Equally difficult is it to imagine a process by which they can gain access to the interior of the growing leaf through the roots, nor have they been traced passing through the tissues of the plant. The author named mentions the fact, however, that Rev. M. J. Berkeley was able to propagate Cluster-cups by growing plants from seeds which had been placed in contact with their spores. Following this hint and noting the fact that the species growing in this vicinity ripened and discharge their spores at the time when the plants on which they are found are in blossom, it was easy to reach the conviction that these spores would be found along with the pollen in the interior of the ovary, thus coming into contact with the seeds and depositing the germs of future growth. Acting upon this hypothesis, I have examined the flowers of *Podophyllum peltatum* and *Arisæma triphyllum* growing within a few feet of plants of the same species whose leaves were covered with Cluster-cups, and in many instances have found the orange-colored spores among the pollen in the ovary. Likewise I have found pollen from *Podophyllum peltatum* mingled with the spores dusted over the leaves of a plant of the same species at a distance of several feet from any blossom, indicating apparently that it had been transported by insects.—*M. A. Veeder.*

NATIONAL COMMITTEE ON MICROMETRY. — Prof. Wm. Ashburner, of San Francisco, Cal., and Rev. Samuel Lockwood, of Freehold, N. J., have been added to this committee.

ERRATUM.—In the last line of "Microscopy," in the last number of the NATURALIST, for "Kill's cement" *read* Bell's cement.

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SCIENTIFIC NEWS.

— Dr. Elliott Coues contributes to the June number of the *Penn Monthly* some interesting correspondence of the ornithologists, Wilson, Ord and Bonaparte.

— A *Sphargis coriacea*, weighing 765 pounds, was recently taken in the Delaware river, near Fort Delaware. It was purchased by Prof. Cope for the Permanent Exposition at Philadelphia.

— The American Association for the Advancement of Science will hold its thirty-eighth meeting at Saratoga, N. Y., opening on Wednesday, August 27th next. The permanent subsection of chemistry will be continued at Saratoga under the chairmanship of Prof. Ira Remsen, of Baltimore. The permanent subsection of microscopy will be presided over by Prof. E. W. Morley, of Hudson, Ohio, and the coöperation of microscopists is requested. The permanent subsection of anthropology has united with section B at the late meetings, a day having been specially allotted to anthropological papers. A chairman was not elected for the Saratoga meeting, but it is understood that this subsection can reorganize at Saratoga should the anthropologists present consider it desirable. In this connection it is proper to note that there will probably be a meeting of the American Anthropological Association during the association week. The attention of entomologists is directed to the annual meeting of the Entomological Club of the association, which will be held at Saratoga on Tuesday, August 26th, at which all interested are invited to be present. Mr. J. A. Lintner, of Albany, is president, and Mr. B. P. Mann, of Cambridge, secretary of the club. At the St. Louis meeting the permanent secretary was directed to call special attention to the desirability of forming a new subsection in the association, which should be devoted to physiology and anatomy, with the special object of inducing members interested in human physiology to bring their papers before the association and also of obtaining the active coöperation of physicians and surgeons in the work of the association. The president of the association is George F. Barker, of Philadelphia, and the permanent secretary, F. W. Putnam, whose address is Salem, Mass.

— The following was recently received at the Philadelphia Zoölogical Garden by the superintendent. On inquiry it proved to be *bona fide:*

"Too the Manager of the zeoological Garden.

Phil June 2 79.

Sir I have Somethinge wich is without any misstack a Grate novilty too the public & is no Cost it is a alactrick Fish wich lives in Fire as well as in water it proueduce fire & Smoke.

PROFF LYONS."

— Charles Hallock, Esq., who is the author of several books on field sports, and the editor and founder of *Forest and Stream*, the well-known sportsman's journal, has just issued a fifth edition of his "Sportsman's Gazetteer and General Guide," a most complete encyclopedia of 921 pages. This book has become a standard authority on all subjects of which it treats; besides, it is endorsed by leading scientists. It has already been republished in England, France and Germany.

— Prof. Viand, Grand Marais in Nantes, France, is desirous of obtaining American lichens in exchange for European.

— Noteworthy arrivals at the Zoölogical Garden, of Philadelphia: 27 undulated grass parrakeets (*Melopsittacus undulatus*); 1 red and yellow macaw (*Ara chloroptera*); 1 red-headed duck (*Fuligula ferina americana*); 1 macaque monkey (*Macacus nemestrinus*), born in the garden; 1 white-fronted parrot (*Chrysotis leucocephalus*); 1 blue-fronted parrot (*Chrysotis cyanorhyncha*); 1 pouched rat (*Geomys bursarius*); 1 whistling swan (*Cygnus americanus*); 2 ostriches, 1 ♂, 1 ♀ (*Struthio camelus*); 1 oryx antelope, ♀ (*Oryx leucoryx*); 1 red monkey (*Cercopithecus ruber*); 1 green monkey (*Cercopithecus callitrichus*); 1 common skunk (*Mephitis mephitica*); 2 green lizards (*Anolis principalis*); 3 prairie wolves (*Canis latrans*); 1 red kangaroo (*Macropus rufus*) and 1 great kangaroo (*Macropus giganteus*), all born in the garden; 2 Pennant's parrakeets (*Platycercus pennantii*); 2 Rosehill parrakeets (*P. eximius*); 2 blood-rumped parrakeets (*P. hæmatonotus*); 4 yellow-collared parrakeets (*P. semitorquatus*); 4 chestnut-eared finches (*Amadina castanotis*); 2 spotted-sided finches (*A. lathami*); 2 chestnut-breasted finches (*Donacola castaneothorax*); 2 maja finches (*Munia maja*); 2 spotted munias (*M. undulatus*); 1 buffalo ♂ (*Bison americanus*), born in the garden; 1 loon (*Colymbus torquatus*); 2 European fallow deer (*Dama vulgaris*) ♂♀; 2 European badgers (*Meles taxus*) ♂♀; 1 gray ichneumon (*Herpestis griseus*); 3 anubis baboons (*Cynocephalus anubis*), 1 emu (*Dromæus novæ-hollandiæ*; 1 scarlet ibis (*Ibis rubra*); 3 bar-headed geese (*Anser indicus*), India; 1 secretary vulture (*Gypogeranus serpentarius*), S. Africa; 4 ring-necked pheasants (*Phasianus torquatus*); 1 darter, or water turkey (*Plotus anhinga*), Florida; 7 white-footed mice (*Hesperomys leucopus*), born in the garden; 1 star-nosed mole (*Condylura cristata*); 2 laughing king-fishers (*Dacelo gigantea*), Australia; 4 Swainson's lorikeets (*Trichoglossus novæ-hollandiæ*); 1 gray parrot (*Psittacus erythacus*); 2 Javan chevrotains (*Tragulus javanicus*) ♂♀, Java and Sumatra.

— We would call attention to Mr. W. N. Lockington's article "The Flounders of our Market" [San Francisco], (Scientific Press Supplement, San Francisco, Cal., Vol. 1, No. 3, April, 1879), as from its place of publication it is likely to escape the eyes of naturalists. There are notes on *Hippoglossoides melanostictus* (Girard sp.) Lockington, *Uropsetta californica* (Ayres sp.) Jordan, *Citharichthys sordidus* Gunther, *Hypsopsetta guttulata* (Girard sp.) Lockington (*Paropheys ayresii* Gunther), *Pleuronichtys cœnosus* Girard, *Parophrys vetula* Girard, *Lepidopsetta bilineata* (Ayres sp.) Jordan, *L. umbrosa* (Girard sp.) Lockington, and *Platichthys stellatus* Günther. Two new species, *Hippoglossoides jordani* and *Glyptocephalus pacificus*, are described.—*J. S. K.*

— An observation lately made by M. Collot, in Panama, lends support to the opinion that the phylloxera is an insect indigenous

in North America, not introduced from Europe with cultivated vines. In the woods of Panama, so far from any center of cultivation of the vine, M. Collot noticed the phylloxera on a wild native vine, which clings to trees after the manner of tropical trullweed.

— The biennial oration in memory of John Hunter was delivered by Prof. Humphry, of Cambridge, F.R.S., in the lecture-room of the Royal College of Surgeons, February 14.

— The following from a recent number of the *Yuma Sentinel*, is not without interest:

"A herd of camels was driven here from Nevada nearly two years ago. Finding no profitable work for them their owners turned them loose along the Gila to the eastward of Yuma. There they have been living and breeding, looking fat and sleek all the time. For a while they were in danger of extermination. Whenever they put in an appearance along the wagon road they frightened mules and horses beyond the control of the drivers. They soon earned the everlasting hatred of teamsters, some of whom acquired a habit of shooting camels at sight. Since, however, the railroad has been delivering freight at Adonde, the road along the Gila, this side of that place, has been comparatively abandoned by teamsters, and the remaining camels have now a good chance to show what they can do in the way of propagation. The waterless desert of Sonora, south and south-east of Yuma, is known to possess immense deposits of salt, sulphur, borax and soda. Its mountains are also known to carry extensive deposits of metals. To these camels we look for eventually making these treasures accessible and available."—*R. E. C. S.*

— The doubt as to whether science or high rank should be represented in the presidency of the Zoölogical Society has been solved by the unanimous election of Mr. William Henry Flower, F.R.S., &c., conservator of the Museum and Hunterian Professor of Comparative Anatomy at the Royal College of Surgeons.

— The Permanent Exposition of Philadelphia, now occupying the main building of the Centennial, has adopted some changes in its organization which will give it a much more specially educational tone than heretofore. It has been divided into ten departments, over each of which a competent chief has been placed. Particular provision has been made for a great museum of the materials of the natural sciences, three of the departments together covering the subjects therein embraced; to these has been assigned a space of six acres within the building. The organization of the executive board is as follows: President, Edward Shippen; secretary and superintendent, W. T. Seal; vice-presidents, Ellis A. Apgar, Geo. F. Barker, Geo. Blight, John F. Hartranft, D. Newlin Fell; chief of the department of inorganic material, Persifor Frazer, Jr.; chief of the department of organic

material, Edward D. Cope; chief of the department of archæology and ethnology, Edwin A. Barber; chief of the department of national architecture, furniture, costumes and traits, George W. Hewitt; chief of the department of model homes, William S. Schofield; chief of the department of agriculture, Willis P. Hazard; chief of the department of machinery, apparatus and manufactures, E. Gybbon Spilsbury; chief of the department of industrial training, Rudolphus Bingham; chief of the department of schools, school-systems and publications, Edward Shippen; chief of the department of fine arts, George W. Pettit.

The prospectus for 1879 contains a series of announcements from Dr. J. A. Paxson, the president, W. T. Seal, secretary, and from each of the chiefs of departments. Those of Profs. Frazer and Cope, and of Mr. Barber, present plans for the classification of their respective museums, which indicate a determination to do their respective charges ample justice. They commence under the favorable conditions of unusually fine collections already in hand, and it will only depend on the public spirited citizens of Philadelphia whether she has a museum appropriate to her population and importance or not. The advantage of having her museums under one roof is almost unique, and should recommend the new organization to immediate support.

— The district of Shantong, in China, contains diamond deposits of a certain importance, but the stones in which the diamonds are found are generally very small—rarely the size of a pea. The following singular artifice (we learn from *Annales Industrielles*) is resorted to by to the Chinese to obtain them. Men wearing large and thick boots made of straw walk in the sand of diamantiferous valleys and watercourses. The diamonds, generally rugose and angular in form, penetrate into the straw, and remain fixed there. Afterwards the boots are collected *en masse* and incinerated, and the precious stones are found among the ashes.—*English Mechanic.*

— We have received the announcement for 1879, of the Appalachian Mountain Club, containing the Constitution and By-laws, list of officers for 1879, and the list of members. The president for this year is Prof. W. H. Niles, of Cambridge, Mass.

— The report on the condition and progress of the Davenport Academy of Natural Sciences, shows that this society is one of the most active in the West, and that this is due largely to two or three individuals, sustained by an enlightened and progressive constituency.

— A number of the citizens of Atlanta have organized a Scientific Association, with the following list of officers, for the purpose of having lectures on scientific subjects delivered weekly free to the public, and to collect a library of scientific works, and to provide a museum of specimens of minerals, rocks, ores, woods, plants

and animals, to be kept open to the public on fixed days, and to workers in science at all times. They have a commodious hall, furnished with shelves, and a janitor in charge of the same. It is near the centre of this growing city of 35,000 inhabitants. Officers, Geo. Little, president; Fred. Bell, vice-president; G. W. Kates, secretary; J. M. Ellis, treasurer; J. S. S. Bell, librarian (pro tem). They have already had about 40 lectures by professors in the State university, and other scientific gentlemen. They would be glad to receive publications as valuable additions to the library. Any contribution to the museum will also be gratefully received.

— The Transactions of the Kansas Academy of Science for 1877 and 1878, contains a number of short articles of much general interest. Prof. F. H. Snow contributed a number of lists of Colorado and Kansas insects. Prof. B. F. Mudge contributes an article entitled, The connection of the fossil forests of the Dakota Groups in Kansas with the fossil forests of Greenland; and S. W. Williston gives a brief popular resumé of existing knowledge of the Dinosauria.

— A number (issued March 4, 1879,) of Siebold and Kölliker's Zeitschrift gives the names of authors and a detailed index of all the articles which have appeared in volumes 16–30, and the supplementary volumes 25 and 30.

— In Ethopia there is found, in subterranean cavities (according to M. Villiers), a honey made without wax by an insect resembling a large mosquito. This honey is called *tazma*. The natives use it to cure throat disease. On analysis, M. Villiers finds it to contain 32 per cent. of mixed fermentable sugars and 28 per cent. of dextrine. The composition is like that of mannas of Sinai and Kurdistan, saccharine matter from the leaves of the lime-tree, and ordinary honey; but it differs from those substances in the absence of cane sugar.

— The results of the disastrous phenomenon of sudden freezing of rain in France, lately referred to, are now coming more freely to light. In a paper in *Revue des Deux Mondes* on the subject, by M. Lamin, it is stated that the forests affected in the Department of Seine-et-Marne have an extent of some 21,000 hectares. The volume of wood broken is estimated at 200,000 steres, the Forest of Fontainebleau alone counting for 150,000 steres. For about fifty years past the Service des Forêts has been seeking to restore the ruined cantons by plantation of Scotch firs. It had thus covered 4000 to 5000 hectares, and every year the woods were carefully thinned for better development. It is now found that these woods of fir have been destroyed in the proportion of sixty to seventy per cent. Some parts, indeed, have been ruined completely. It will be necessary to raze immense portions and commence anew. The work of restoration of the Forest of Fontainebleau has been thrown back thirty years.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

NEW YORK ACADEMY OF SCIENCES.—Geological Section, April 21st, 1879.—Prof. Arnold Guyot, of Princeton College, presented a paper upon "The Topography of the Catskills," embodying some of the leading points brought out during several years' summer study of these mountains, and now nearly ready for publication. It seems extraordinary that a region like this, in the oldest part of the country as regards settlement, and long celebrated as a resort for travelers, hunters, artists, etc., should have remained so largely an unknown wilderness even to this very day. It was reserved for Prof. Guyot, within a few summers past, actually to discover and name an extensive group of mountains, rising into peaks in some cases over 4000 feet high. This group —the "Southern Catskills," or "Shandakens," was not laid down on any map or described in any gazetteer; and when Prof. Guyot first looked out upon it from a southern height of the main Catskills, he had the surprising experience of a new discovery in the heart of the State of New York. The gazetteers had mentioned it as a hilly country, merely; and the fact that it contains mountains higher than the true Catskills, was new to geographical science. The scantiness of our knowledge regarding all this region —save in the immediate vicinity of the summer resorts—is due largely to the dense forest with which the slopes and summits are clothed, which renders it very difficult to gain connected and extensive views.

Prof. Guyot divides the whole group into two, as already intimated, the true Catskills and the Shandakens or Southern Catskills, separated by the valley of Esopus Creek. From the former flow the Catskill creek into the Hudson, Schoharie Creek into the Mohawk, and numerous affluents of the Upper Delaware; from the latter flow Esopus Creek and Rondout River, into the Hudson, and Neversink River into the Delaware. The mountains exhibit a series of long sub-parallel ranges, trending S.E. and N.W., nearly at right-angles to the general Appalachian course; and this fact, at first, would cause perplexity to the geologist. More careful study, however, removes this apparent anomaly; as these ranges are seen to be simply the result of denudation, excavating an elevated table land; while if a line be drawn from peak to peak of the loftiest summits, it appears that this line will take the N.E. and S.W. course of the Appalachian system. The most prominent summits, which thus mark out the central elevated ridge of the now-excavated plateau, are Black Top, on the northernmost range of the true Catskills, Hunter mountain, on the southern range, and Slide mountain, in the Shandakens, all of which are over 4000 feet high.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, Feb. 25.—The President, Dr. Ruschenberger, in the Chair. Dr. Goldsmith exhibited some specimens of

Asphaltum from the marl of Vincenttown, N. J., and a peculiar amber from the same source which was considered to be *Krantzite*. Dr. König exhibited his *Chromometer*, an apparatus devised for the purpose of making quantitative analysis of ores by the effect upon beads made by fusion with borax of their complementary colors as seen through red or green prisms of very small divergence.

Microscopical and Biological Section of the Academy, Feb. 3. —Prof. Wm. Barbeck delivered an illustrated lecture on the smuts, rusts and molds injurious to cereal grains.

Feb. 17.—Dr. J. Gibbons Hunt delivered a lecture on the mosses and liverworts.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

PSYCHE.—March. Geographical distribution of North American Coleoptera, by E. P. Austin.

JENAISCHE ZEITSCHRIFT FUR NATURWISSENSCHAFT.—April 15. The comparative anatomy of the digestive system of birds, by H. Gadow; part 1, with eight plates. (Contains many figures of the digestive tract, together with its appendages,of the ratitate and carinate birds, a very useful work).

AMERICAN JOURNAL OF SCIENCE AND ARTS.—May. Experiments in cross-breeding plants of the same variety, by W. J. Beal. Hudson river age of the Taconic schists, etc., by J. D. Dana.

THE GEOLOGICAL MAGAZINE. — May. Notes on Palæozoic Crustacea, by H. Woodward. On Prof. Dana's classification of rocks, by Prof. Bonney. On plagioclinal mountains, by C. Calloway.

AMERICAN GEOGRAPHICAL SOCIETY, May 13.—Mr. A. A. Hayes, Jr., read a paper on modern ocean highways.

June 2.—Mr. J. S. Lamson exhibited specimens of the prehistoric pottery and other antiquities recently procured from graves in Chiriqui, Central America, with some account of the mode of their occurrence.

APPALACHIAN MOUNTAIN CLUB, May 14.—Prof. J. H. Huntington read a paper entitled, From the Forks of the Kennebec to Lake Megantic, and Prof. W. H. Niles explained the use of the Alpine rope.

May 17, there was an excursion to Prospect Hill, Waltham, Mass.

BOSTON SOCIETY OF NATURAL HISTORY, May 7.—Mr. M. E. Wadsworth discussed the classification of rocks, and Dr. T. M. Brewer noticed certain birds of New England.

May 21.—Dr. T. M. Brewer continued his notices of New England birds, and Mr. S. H. Scudder remarked on the earliest cockroaches.

TROY SCIENTIFIC ASSOCIATION, May 19.—Dr. R. H. Ward made an address on mountain vegetation.